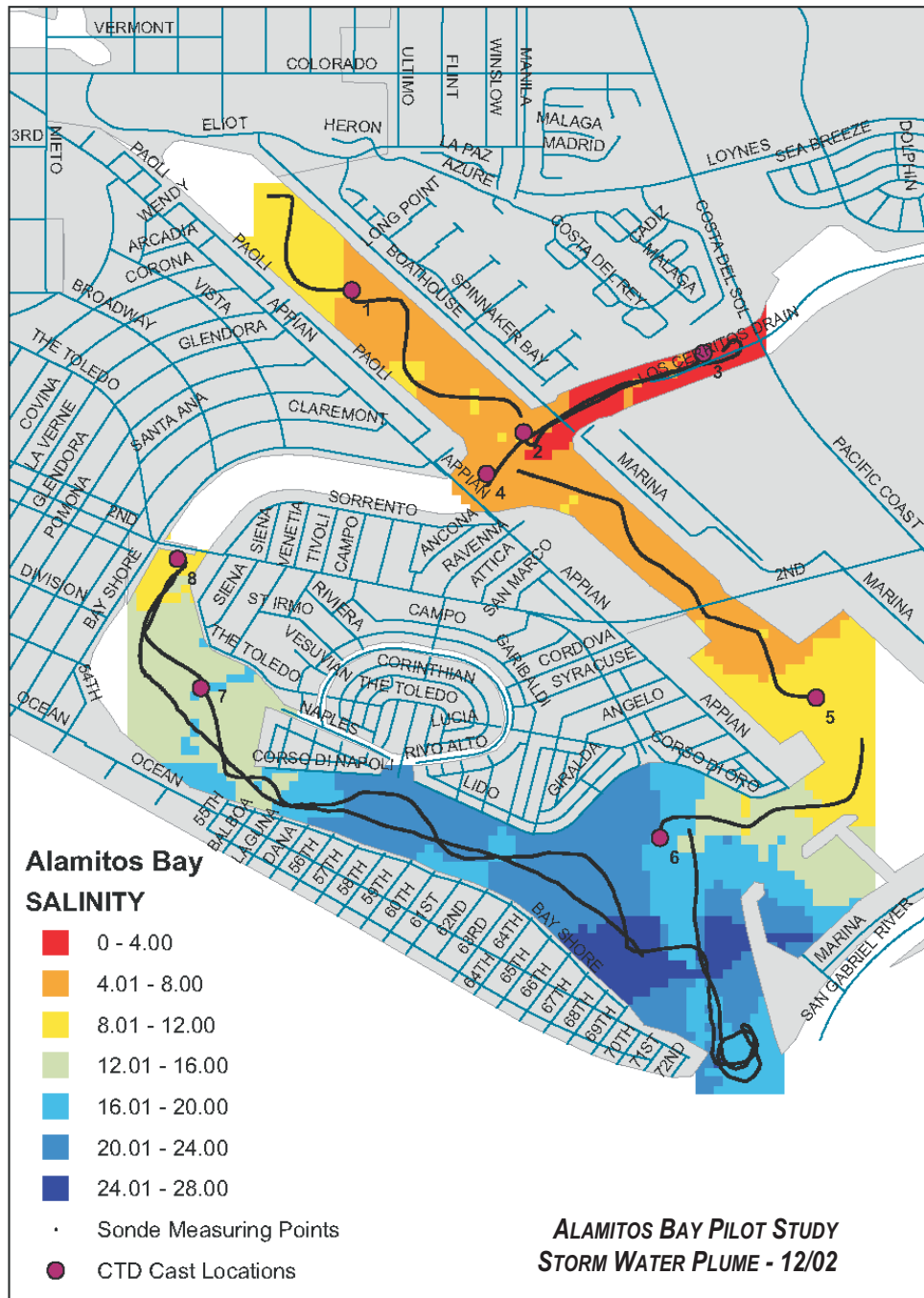


# CITY OF LONG BEACH

## STORM WATER MONITORING REPORT 2002-2003

NPDES PERMIT No. CAS004003 (CI 8052)



SUBMITTED BY  
**CITY  
OF  
LONG  
BEACH**

**JULY 2003**

PREPARED BY  
**KINNETIC LABORATORIES, INC.**

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**NPDES PERMIT NO. CAS004003 (CI 8052)**

**JULY 2003**

**PREPARED BY**

**KINNETIC LABORATORIES, INC.**

**AND**

**SOUTHERN CALIFORNIA COASTAL  
WATER RESEARCH PROJECT**



**SUBMITTED BY**

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OF  
LONG  
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## ACRONYMNS AND ABBREVIATIONS LIST

ASTM - American Society for Testing and Materials  
BHC - Benzene hexachloride  
BMP - Best Management Practice  
BOD- Biological Oxygen Demand  
CCC – Criterion Continuous Concentration  
CD - Compact Disk  
CFU - Colony Forming Units  
CMC – Criterion Maximum Concentration  
COD - Chemical Oxygen Demand  
CRWQCB – California Regional Water Quality Control Board  
CTR - California Toxics Rule  
2,4 D - 2,4-dichlorophenoxy  
2,4 DB - (2,4-dichlorophenoxy) butanoic acid  
DDD - dichloro (p-chlorophenyl)ethane  
DDE - dichloro (p-chlorophenyl)ethylene  
DDT - dichlorodiphenyl trichloroethane  
DF - dilution factor  
DI - Deionized  
DL - Detection Limit (considered the same as RL)  
DO - Dissolved Oxygen  
EC<sub>50</sub> - Concentration causing effects to 50% of the test population  
EDTA - ethylene diamine triacetic acid  
EMC- Event mean concentration  
GIS - Geographic Information System  
IC25 - Concentration causing 25% inhibition in growth or reproduction  
IC50 - Concentration causing 50% inhibition in growth or reproduction  
ICP-MS - Inductively Coupled Plasma-Mass Spectrometry  
Halocline – a locally steepened vertical gradient of salinity  
KLASS - Kinnetic Laboratories Automated Sampling System  
KLI - Kinnetic Laboratories, Inc.  
LC<sub>50</sub> - Bioassay concentration that produces 50% lethality  
LDPE - Low Density Polyethylene  
LOEC - Lowest Observed Effect Concentration  
LPC - Limiting Permissible Concentration  
MBAS - methylene-blue-active substances  
MCPA - 2-methyl-4-chloro-phenoxy acetic acid  
MCPP - 2-(4-chloro-2-methylphenoxy) propanoic acid  
ML – Minimum level as defined in State Implementation Plan  
MPN- Most Probable Number  
MS4 - Multiple Separate Storm Sewer System  
MTBE- Methyl Tertiary Butyl Ether  
NADP-National Atmospheric Deposition Program  
NCDC-National Climate Data Center  
NPDES –National Pollutant Discharge Elimination System  
NOEC - No observed effect concentration  
NTS - Not to Scale  
NTU - nephelometric turbidity units

NURP- Nationwide Urban Runoff Program  
 PAH - Polynuclear Aromatic Hydrocarbons  
 PCB - Polychlorinated bi-phenyls  
 PDF - Portable Document Format  
 ppb - Parts per Billion  
 Q - Flow  
 QA/QC - Quality Assurance/Quality Control  
 RMP - Regional Monitoring Program  
 RL- Reporting Limit (considered the same as DL)  
 RPD- Relative Percent Difference  
 SAP - Sampling and Analysis Plan  
 SCCWRP - Southern California Coastal Water Research Project  
 sf- Square Feet  
 SIP – State Implementation Plan  
 SM- Standard Methods for the Examination of Water and Wastewater  
 SOP - Standard Operating Procedure  
 SRM - Standard Reference Material  
 STS - sodium tetradecyl sulfate  
 SV - Semi-Volatile Compound  
 SWRCB-State Water Resource Control Board  
 2, 4, 5-TP - 2-(2,4,5-trichlorophenoxy) propanoic acid  
 2, 4, 5-T - 2,4,5-trichlorophenoxy  
 TDS – Total Dissolved Solids  
 TIE – Toxicity Identification Evaluation  
 TKN- Total Kjeldahl Nitrogen  
 TOC - Total Organic Carbons  
 2, 4, 5-TP - 2-(2,4,5-trichlorophenoxy) propanoic acid  
 TPH - total petroleum hydrocarbons  
 TRPH - Total Recoverable Petroleum Hydrocarbons  
 TSI - ToxScan, Inc.  
 TSS –Total Suspended Solids  
 TU - Toxicity Unit  
 TUc – Chronic Toxicity Unit  
 USEPA - U.S. Environmental Protection Agency  
 WQO - Water Quality Objective  
 WQS - Water Quality Standard

**CITY OF LONG BEACH  
STORMWATER MONITORING REPORT 2002/2003**

**NPDES Permit No. CAS004003 (CI 8052)**

## **1.0 EXECUTIVE SUMMARY**

### **1.1 Background and Purpose**

The City of Long Beach was required to conduct a water quality monitoring program for stormwater and dry weather discharges through the City's municipal separate storm sewer system (MS4) beginning in the 1999/2000 wet weather season under terms of Order No. 99-060 National Pollutant Discharge Elimination Systems Municipal Permit No. CAS004003 (CI 8052).

The monitoring program called for monitoring mass emissions and toxicity at three representative mass emission sites during the first wet season and four sites for subsequent wet seasons. Four wet weather storm events were to be monitored annually. Monitoring during the first two years also included a receiving water site (Alamitos Bay) be monitored with each wet weather storm event.

Dry weather inspections and the collection and analysis of dry weather discharges were required at each of these monitoring sites over two different 24-hour periods during each dry season. Water samples collected at the monitoring sites during each time period were to be analyzed for all parameters specified in the permit and tested for toxicity. The program also initially called for monitoring the receiving water body site (Alamitos Bay) for bacteria and toxicity to provide water quality information during the dry seasons and on the effectiveness of a dry-weather diversion.

Monitoring sites specified in the permit are as follows:

- Basin 14: Dominguez Gap Pump Station Monitoring Site
- Basin 20: Bouton Creek Monitoring Site
- Basin 23: Belmont Pump Station Monitoring Site
- Basin 27: Los Cerritos Channel Monitoring Site (Starting in Second Year)
- Alamitos Bay Receiving Water Monitoring Site

During the first 1999/2000 wet weather season, start-up delays associated with permitting for placement of stormwater monitoring equipment in the Los Angeles County Flood Control District facilities prevented the wet weather monitoring from being carried out. Instead, a special research study on Parking Lot Runoff was carried out with the permission of the Regional Water Quality Control Board staff. In addition, the required dry weather monitoring was carried out for this first year. A previous report (Kinnetic Laboratories, Inc., 2000) covered the first season dry-weather monitoring events performed in June of 2000 as well as one additional receiving water sampling in April 2000. Subsequent reports have summarized the results of both second (Kinnetic Laboratories, Inc., 2001) and third (Kinnetic Laboratories, Inc. 2002) wet and dry season monitoring programs.

The purpose of this present report is to submit the results of the City of Long Beach's stormwater monitoring program for the fourth year, 2002/2003. Kinnetic Laboratories, Inc. conducted this monitoring program as Prime Contractor to the City of Long Beach. Toxicity testing and chemical analyses were conducted by ToxScan, Inc. Analytical laboratory services were supplemented by other

participating laboratories as necessary. North Coast Analytical analyzed the chlorinated herbicides and Associated Labs analyzed the grab samples for bacteria and hexavalent chromium.

## **1.2 Summary of Results**

Wet weather sampling of storm events began in November 2002. The first major storm of the year was sampled on November 11. During this wet weather season, the targeted number of four storm events were monitored at all of the City of Long Beach's mass emission stations, with the exception of the Dominguez Gap Pump Station where only three overflow discharge events occurred. Discharges from the Dominguez Gap Pump Station all happened late in the storm season. Two of the events were sampled in concert with storm events at the other stations. The third event at this site was sampled only at the Dominguez Gap Pump Station since sampling requirements had been completed at the other mass emission sites.

In a letter dated November 13, 2002, the Executive Officer of the California Regional Water Quality Control Board, Los Angeles Region issued adjustments to the monitoring program. Included in the changes was implementation of a pilot receiving water study. This study was conducted on December 16<sup>th</sup> following the second event of the season. The horizontal and vertical extent of the stormwater plume in Alamitos Bay was delineated and water samples were taken from four different locations in the plume. Sampling locations represented a range of salinities within the plume that ranged from 8.7 to 24.9 ppt. Water samples were tested for toxicity and a subset of water quality parameters which included selected trace metals and organophosphorous pesticides.

Two dry weather inspections/monitoring events were conducted. The first was conducted in September 2002 prior to the winter rains. The second was conducted in May 2003 once winter rains had subsided. Dry weather monitoring was conducted for the three mass emission sites that exhibited dry weather flows. These included Bouton Creek, the Belmont Pump Station, and the Los Cerritos Channel.

The results of the City of Long Beach's 2002/2003 stormwater monitoring program are summarized as follows:

### **Wet Weather Chemical and Bacterial Results**

Numerical standards do not exist for stormwater discharges. However, water quality criteria or objectives may provide reference points for assessing the relative importance of various stormwater contaminants, though specific receiving water studies are necessary to quantify the presence and magnitude of any actual water quality impacts. The California Ocean Plan (SWRCB 2002), the Los Angeles Region Basin Plan (CRWQCB, Los Angeles Region. 1994), AB411 public health criteria, and both saltwater and freshwater criteria from the California Toxics Rule (USEPA 2000) were used as benchmarks as requested by Regional Board staff. Not all of these criteria are appropriate for Long Beach discharges or for comparison with stormwater runoff water quality. In order for these comparisons to be useful it is important that a regional strategy be developed that provides consistent and appropriate benchmarks.

- Total suspended solids (TSS) in the Long Beach wet weather discharges exceeded the Ocean Plan criterion of 3 mg/L in all cases. This is an open ocean, not estuarine standard and all stormwater runoff would be expected to exceed this criterion. Therefore this standard is not applicable for evaluation of stormwater discharges.

- The pH of stormwater discharges from Long Beach typically ranged from 6.2 to 6.8. More than half of the stormwater samples had pH values that were below the lower Basin Plan limits of 6.5. Stormwater discharged from the Dominguez Gap Pump Station on February 25, 2003 had a pH of 5.4. Low pH in stormwater is not unusual since rainwater is slightly acidic due to dissolved carbon dioxide scavenged from the atmosphere. The average pH of rainwater in Southern California is reported to be approximately 5.2 (NADP 2003).
- Concentrations of bacteria (total coliform, fecal coliform, and enterococcus) in the Long Beach stormwater discharges routinely exceed public health criteria provided by AB411 and the Ocean Plan. Both total and fecal coliform concentrations exceeded criteria in 100 percent of the stormwater samples. Enterococcus concentrations exceeded AB411 criteria during all but one event when reported values were below criteria at three sites. Other studies have shown that such exceedances are not limited to urban stormwater sources but are also measured in stormwater discharges from undeveloped surrounding land.
- Total recoverable metal concentrations were compared against the Ocean Plan's aquatic life criteria and the Basin Plan drinking water quality objectives. Concentrations of total recoverable copper, lead and zinc exceeded Ocean Plan criteria in 80 to 100 percent of the samples. Stormwater runoff from the Dominguez Gap Pump Station tended to have lower levels of total metals. Lead and zinc criteria were exceeded in only one-third of the events at this site.
- Total recoverable aluminum exceeded the Basin Plan drinking water criterion of 1000 µg/L during all events at all sites. The Basin Plan drinking water criterion of 6 µg/L was slightly exceeded during one event in water discharged from the Los Cerritos Channel.
- Dissolved metal concentrations were compared against both saltwater and freshwater Criteria Continuous Concentrations (CCC) values from the California Toxics Rule (CTR). Dissolved copper, lead and zinc commonly exceeded the reference values. Concentrations of dissolved copper exceeded both the freshwater and saltwater CTR criteria at all sites during all storm events. Dissolved lead and zinc exceeded the CTR criteria during all storm events at Bouton Creek, the Belmont Pump Station and Los Cerritos Channel. Lead and zinc criteria were exceeded in two out of three events at the Dominguez Gap Pump Station.
- Very few organic compounds exceeded the reference criteria in runoff from the four mass emission sites. Concentrations of dieldrin exceeded the saltwater CTR criterion in one sample from the Belmont Pump site and another from the Los Cerritos Channel. In both cases, the reported value was less than twice the Minimum Level<sup>1</sup> (ML) of 0.01 µg/L. Simazine, an organophosphorus herbicide, exceeded the Basin Plan Maximum Contaminant Level (MCL) in one sample from the Los Cerritos Channel.
- Among the four mass emission sites, the Los Cerritos Channel consistently exhibited the highest overall loads of solids and total metals. Estimates of solids discharged at the Los Cerritos Channel site ranged from 92,163 to 704,927 pounds. Estimates of total copper, one of the most significant urban contaminants, ranged from 14 to 143 pounds. In contrast, the Belmont Pump Station was estimated to discharge between 397 and 4018 pounds of solids and 0.22 to 1.7 pounds of copper during each event.

---

<sup>1</sup> The minimum level represents the lowest quantifiable concentration in a sample based on the proper application of all method-based analytical procedures and the absence of any matrix interferences.

### **Dry Weather Chemical and Bacterial Results**

- In general, the concentrations of suspended particulates and total recoverable metal concentrations continue to be low in dry weather runoff. Trace metals are predominantly in the dissolved form. Hardness is also consistently high which tends to mitigate the effects of the dissolved metals. Concentrations of bacteria exceed public health criteria and are comparable to levels in stormwater runoff. Pesticides and semivolatiles were largely undetected.
- Sampling conducted at Bouton Creek in May 2003 resulted in elevated levels of TSS, turbidity, total recoverable metals (aluminum, copper, iron, lead, selenium, silver and zinc) and dissolved selenium. The results of this survey suggest that there was an upstream source of sediment at this location at that time. Possible sources are being investigated.
- As in previous years, no dry weather discharges were observed from the Dominguez Gap Pump Station.

### **Alamitos Bay Pilot Receiving Water Program**

Monitoring of a stormwater plume in Alamitos Bay was conducted on December 16, 2002 following a brief, but intense storm event. The storm lasted for four to five hours producing 1.21 to 1.26 inches. Runoff during the storm resulted in a surface plume that extended throughout Alamitos Bay. Sampling was conducted at four dilutions within the plume for chemical and toxicological testing. Salinities of each sampling location were 24.7 ppt (RW1), 16.5 ppt (RW2), 10.9 ppt (RW3) and 8.7 ppt (RW4).

- Measured surface salinity within Alamitos Bay ranged from 1 to 28 ppt. The lower part of the range was found within the lower reaches of the Los Cerritos Channel near the Pacific Coast Highway Bridge. The higher surface salinities occurred near the Bay entrance.
- The fresher water of stormwater plume generally formed a surface plume that was typically three to five feet in depth.
- The stormwater plume tended to be cooler and more turbid than the underlying marine waters. Temperatures in the plume were typically one degree centigrade lower than the deeper marine waters. Turbidity in the surface plume ranged from 45 to 80 NTU. Marine water under the plume was relatively clear with turbidity measurements typically in the range of 2 to 5 NTU.
- Total suspended solids increased from 10 to 28 mg/L as the surface salinity decreased from 24.7 to 8.7 ppt. Similarly, total copper, nickel, lead and zinc concentrations also increased with decreasing salinity. Concentrations generally doubled over the salinity gradient. Total cadmium was relatively constant with values ranging from 0.09 to 0.12 µg/L.
- Strong spatial trends were not evident in the distribution of dissolved metals.
- Organophosphate (OP) pesticides were mostly not detected. Simazine, an herbicide, was the only OP pesticide detected in the plume. Concentrations were similar at all locations with levels ranging from 1.1 to 1.3 µg/L.
- Water samples from the four plume sites were tested for toxicity using the sea urchin fertilization test showed negligible toxicity. All EC50s were >50%. Toxicity testing of stormwater

discharges from the mass emission sites demonstrated a similar lack of toxicity, consistent with the high dilutions due to the large rainfall and low toxicity in stormwater runoff samples from the mass emission sites.

### **Temporal Trends in Constituents of Concern**

Although data are not yet sufficient to make definitive statements supported by statistical test, several general trends are emerging. Major observations include:

- Dissolved concentrations of cadmium, copper, nickel and lead appear to be comparable during both wet and dry weather periods. Unlike these four metals, dissolved zinc concentrations are consistently higher during storm events.
- Concentrations of total copper, lead and zinc are distinctly higher in association with storm flows.
- No distinct seasonal or year to year differences are evident in concentrations of total cadmium, total nickel, chlorpyrifos or diazinon.
- Characteristics of stormwater discharges from the Dominguez Gap Pump Station are consistent with earlier observations at this site. Discharges from this site tend have lower concentrations of total metals than the other mass emission sites.

### **Toxicity Results**

- Toxicity to one or more test organisms was detected at three of the four stations sampled this year for each of the four wet weather storm events. Water flea toxicity was seen during the first two storms at the Belmont and Cerritos stations, but not at all at the Bouton station. No wet weather water flea toxicity was detected after the second storm. Sea urchin toxicity was seen during the first storm at Belmont, Bouton and Dominguez stations, and again during the second and fourth storms at Bouton and the third storm at Cerritos. No toxicity was detected at Dominguez during the only (third) storm when that station was sampled. The toxicity measured was less this year, possibly because there were fewer storms last year. The frequency and magnitude of stormwater toxicity from the Long Beach stations during this monitoring period were markedly reduced from both previous Long Beach stormwater programs and stormwater samples from other southern California watersheds. The Chollas Creek (San Diego) and Ballona Creek (Santa Monica) were most similar to the Long Beach study, as these samples were obtained from smaller highly urbanized watersheds relative to the Los Angeles River and San Gabriel River.
- Toxicity was measured in all of the dry weather samples except those from Belmont Pump station, where there was only very slight toxicity to water fleas in September. The magnitude of toxicity was not consistently less than that measured in the wet weather samples as seen in previous Long Beach studies. These results do not support the hypothesis suggesting significant differences in the composition of stormwater and dry weather discharge from the City of Long Beach.
- Perhaps indicative of the generally reduced magnitude of toxicity seen during this testing program, only five TIEs (four wet weather and one dry weather) were triggered in 2002/2003. There were limited TIE procedures incorporated into two additional dry weather samples.

Virtually all of the TIE attempts were abandoned due to loss of toxicity in the laboratory, but useful data were salvaged on 10 samples. The results of this year were consistent within each species and similar to those obtained from the previous year.

- All TIEs conducted using the water flea indicated that organophosphate pesticides were the most likely category of toxic constituents.
- The three-year toxicity data set also implicated dissolved metals, including copper, lead, nickel and zinc, as causes of stormwater toxicity. These conclusions are supported by the TIE results, by correlations of toxicity with chemical constituents, and by calculations of predicted toxicity based upon measured zinc and organophosphate pesticide concentrations in the stormwater.



## 2.0 INTRODUCTION

The City of Long Beach serves a population of about 481,000<sup>2</sup> people in an area of approximately 50 square miles. The discharges from the MS4 system consist of surface runoff (non-stormwater and stormwater) from various land uses in the hydrologic drainage basins within the City. Approximately 44% of the land area discharges to the Los Angeles River, 7% to the San Gabriel River, and the remaining 49% drains directly to Long Beach Harbor and San Pedro Bay (City of Long Beach Municipal Stormwater Permit, 1999). The quality and quantity of these discharges vary considerably and are affected by the hydrology, geology, and land use characteristics of the watersheds; seasonal weather patterns; and frequency and duration of storm events. Impairments or threatened impairments of beneficial uses of water bodies in Long Beach include Alamitos Bay, Los Angeles River, El Dorado Lake, Los Angeles River Reach 1 and Reach 2, San Gabriel River Estuary, San Gabriel River Reach 1, Colorado Lagoon, and Los Cerritos Channel. These areas also include coastal shorelines, including Alamitos Bay Beaches, Belmont shore Beach, Bluff Park Beach, and Long Beach Shore.

The City of Long Beach received an NPDES Permit issued by the California Regional Water Quality Control Board, Los Angeles Region on 30 June 1999 (Order No 99-060, NPDES No. CAS004003, (CI 8052)). This order defined Waste Discharge Requirements for Municipal Stormwater and Urban Runoff discharges within the City of Long Beach. Specifically, the permit regulates discharges of stormwater and urban runoff from municipal separate storm sewer systems (MS4s), also called storm drain systems, into receiving waters of the Los Angeles Basin.

The NPDES permit requires the City of Long Beach to prepare, maintain, and update if necessary a monitoring plan. The specified monitoring plan required the City to monitor three (Year 1) and four (Years 2 through 5) discharge sites draining representative urban watersheds (mass emission sites) during the first two years of the monitoring program. Flow, chemical analysis of water quality, and toxicity were to be monitored at each of these sites for four representative storm events each year. During the dry season, inspections and monitoring of these same discharge sites were to be carried out, with the same water quality characterization and toxicity tests to be run. In addition, one receiving water body (Alamitos Bay) was to be monitored during the first two years of the program for bacteria and toxicity. Monitoring at the Alamitos Bay site was to be conducted during both the wet and the dry seasons and was to be used to document the effect of a dry weather diversion.

The Regional Board first modified the permit by letter on October 24, 2001 based upon review of the second year report and concurrent modifications being negotiated on the Los Angeles County stormwater permit. Permit modifications consisted of three primary elements. The first modification was an adjustment to the list of constituents and the required reporting limits for consistency with Minimum Levels (MLs) listed in the State's *Policy for Implementation of Toxics Standards for Inland Surface Waters, Enclosed Bays and Estuaries of California* (SIP). The second change addressed the requirements for triggering TIEs and a reduction in toxicity testing requirements for the mysid, *Americamysis*. TIE triggers were changed to enhance opportunities for defining toxicity that might be related to first flush or other early season events. Testing of mysids was reduced to conducting these tests only during the first event of the season. The final change was a requirement to compare stormwater quality data to water quality criteria applicable to specific beneficial uses in each receiving water body.

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<sup>2</sup> Population estimate as of January 1, 2003. State of California Department of Finance Demographic Research Unit

After reviewing the third year report, the Regional Board issued another letter on November 13, 2002 that provided further adjustments to the monitoring program. Major changes included:

- continuation of monitoring at the Dominguez Pump Station site but suspension of toxicity testing at this site,
- elimination of monitoring requirements for semi-volatile organic compounds during the 2002/2003 season while investigating alternative sampling and analytical approaches to obtain lower detection limits in subsequent years,
- elimination of the Alamitos Bay Receiving Water Site,
- implementation of a pilot receiving water program, and
- implementation of upstream investigations if extreme pH values are encountered during Dry Weather monitoring at any of the Mass Emission Stations.

The purpose of this report is analyze the samples and data collected during the 2002/2003 permit year and to present the results from the fourth year of the City of Long Beach's stormwater monitoring program.

### **3.0 STUDY AREA DESCRIPTION**

The four sites for mass emissions monitoring were originally selected by the City of Long Beach with the assistance of the Southern California Coastal Water Research Project (SCCWRP), with input from the Los Angeles Department of Public Works, the environmental community, and with the approval of the Regional Water Quality Control Board. These sites were then specified in the NPDES permit after an analysis of the drainage basins and receiving waters. They were selected to be representative of the stormwater discharges from the City's storm drain system, as well as to be practical sites to carry out stormwater and dry weather monitoring. An additional site in Alamitos Bay was also selected as representative of receiving waters and for evaluation of the effectiveness of a dry weather diversion.

#### **3.1 Regional Setting**

##### **3.1.1 Geography**

The City of Long Beach is located in the center and southern part of the Los Angeles Basin (Figure 3.1) and is part of the highly urbanized Los Angeles region. In addition to residential and other uses, the City also encompasses heavy industrial and commercial areas and includes a major port facility, one of the largest in the United States. The City's waterfront is protected from the open Pacific Ocean by the extensive rock dikes encircling the outer harbor area of the Port of Los Angeles/Port of Long Beach complex. The waterfront includes port facilities along with a downtown commercial/residential area that includes small boat marinas, recreational areas, and convention facilities. Topography within the City boundaries can be generally characterized as low relief, with Signal Hill being the most prominent topographic feature (Figure 3.2).

##### **3.1.2 Major Watersheds**

Major water bodies receiving stormwater discharges from the City of Long Beach include the Los Angeles River located near the western boundary of the City, the San Gabriel River located near the eastern boundary, and the outer Harbor of the Los Angeles/Long Beach area. The City of Long Beach has fifteen pump stations that discharge into the Los Angeles River, and one pump station that discharges into the San Gabriel River. Receiving water sub-areas of importance include the extensive Alamitos Bay, heavily developed for marina and recreational uses, and the inner harbor areas of the City, heavily developed as port facilities. Other receiving water sub-areas include the Los Angeles River, El Dorado Lake, Los Angeles River Reach 1 and Reach 2, San Gabriel River Estuary, San Gabriel River Reach 1, Colorado Lagoon, and Los Cerritos Channel. These areas also include coastal shorelines, including Alamitos Bay Beaches, Belmont Shore Beach, Bluff Park Beach, and Long Beach Shore. The drainage from the City is characterized by major creeks or storm channels, usually diked and/or concrete lined such as the Los Cerritos Channel that originates in Long Beach, flows near the eastern City boundary, and discharges into the Marine Stadium and then into Alamitos Bay. Other such regional drains include:

- Coyote Creek, which passes through a small portion of Long Beach before it discharges to the San Gabriel River;
- Heather Channel and Los Cerritos Line E that both enter Long Beach from the City of Lakewood and discharge into the Los Cerritos Channel; and the
- Artesia-Norwalk Drain that enters Long Beach from Hawaiian Gardens and discharges into Coyote Creek.

The City of Long Beach, including the City of Signal Hill, is divided into 30 watersheds as shown in Figure 3.3. Data presently in the City of Long Beach GIS database on total areas and specific land use categories for each basin are given in Table 3.1 (City of Long Beach 2001). Specific watersheds selected by the City of Long Beach for this present stormwater monitoring program are described in more detail in the following section.

### **3.1.3 Annual Rainfall and Climate**

The City of Long Beach is located in the semi-arid Southern California coastal area and receives significant rainfall on a seasonal basis. The rain season generally extends from October through April, with the heavier rains more likely in the months of November through March (see Figure 5.1 for average rainfall by month and seasonal total rainfall as measured at the Long Beach Airport). The long-term average rainfall for October through April at the Long Beach Airport is 12.27 inches per year.

The City lies in the Los Angeles Plain, which is south of the Santa Monica and San Gabriel Mountains and west of the San Jose and the Puente Hills. The Los Angeles River is the largest stream on the Plain and it drains the San Fernando Valley and much of the San Gabriel Mountains. Most of the streams are dry during the summer and there are no lakes or ponds, other than temporary ponding behind dunes (Miles & Goudy, 1998). The climate is mild, with a 30-year average temperature of 23.4 °C (74.1°F) at the Long Beach Daugherty Airport (NCDC, 2000).

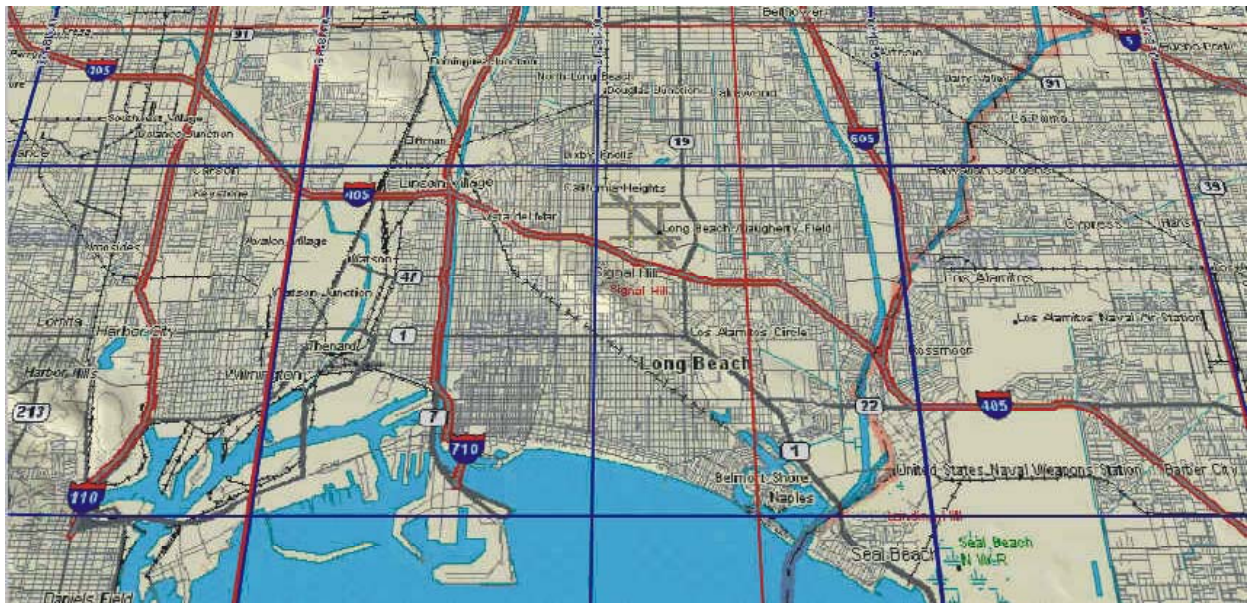
### **3.1.4 Population and Land Use Characteristics**

The population of the City of Long Beach totaled approximately 481,000 residents in January 2003 (California Department of Finance Demographic Research Unit, 2003). The total population of the County of Los Angeles, in which it resides, was 9,979,600. The independent city of Signal Hill, located on a promontory, is surrounded by the City of Long Beach. Signal Hill's population was recently estimated to be 10,300. Signal Hill contributes runoff to drainage basins 6, 7, 8, 9 and 18.

The City of Long Beach has a total area of 26,616 acres. Of that total 16,926 acres (64%) are classified as residential, 4,784 acres (18%) as commercial, 2,269 acres (8.5%) as industrial, 1,846 (7%) as institutional, and 786 acres (3%) as open space (City of Long Beach, 1999). The drainage basins sampled for the stormwater monitoring study follow this general pattern of land use.

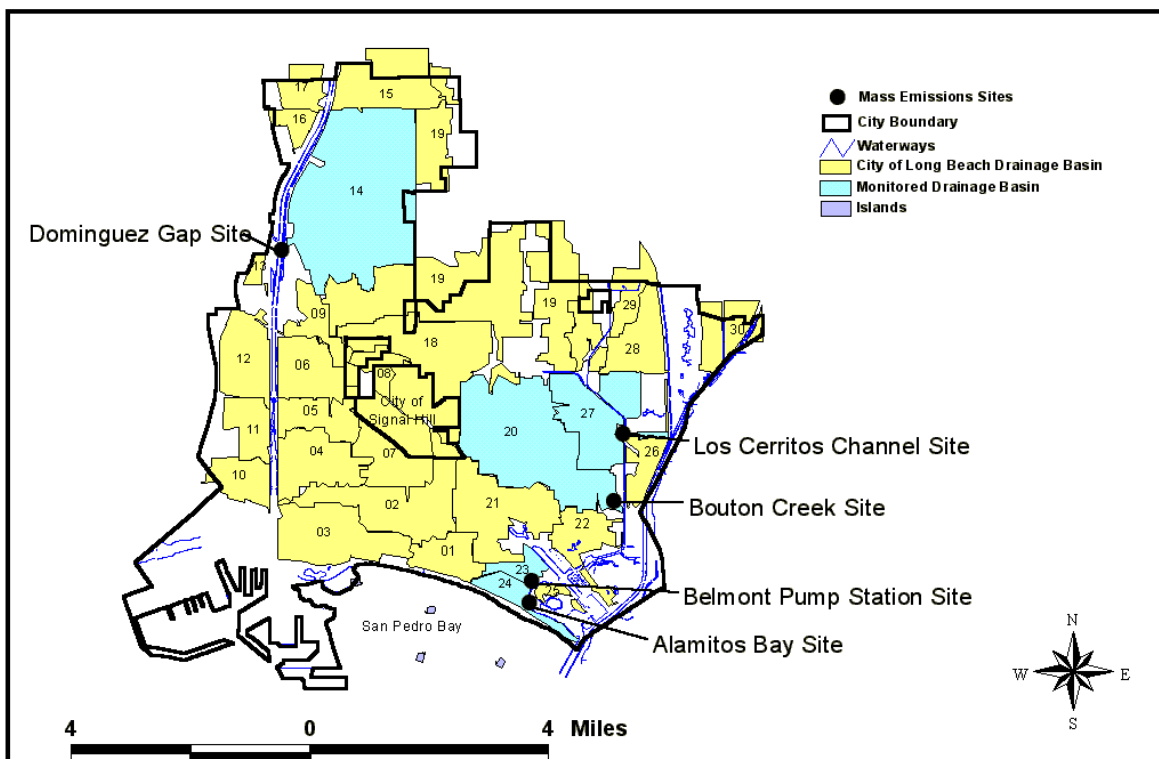


**Figure 3.1** Los Angeles Basin. (Source: 3-D TopoQuads Copyright 1999 DeLorme, Yarmouth, ME 04096).



**Figure 3.2** City of Long Beach. (Source: 3-D TopoQuads Copyright 1999 DeLorme, Yarmouth, ME 04096).

## Major Drainage Basins and Monitoring Sites



**Figure 3.3** City of Long Beach Major Drainage Basins (Source: City of Long Beach, Department of Technology Services, last update 1994) and City of Long Beach Stormwater Monitoring Sites.

**Table 3.1 Total Areas and Land Use for City of Long Beach Watersheds.**

<b>Drainage Basin</b>	<b>Drainage Pattern</b>	<b>Sub-basins</b>	<b>Total Acres</b>	<b>Residential Acres</b>	<b>Commercial Acres</b>	<b>Industrial Acres</b>	<b>Institutional Acres</b>	<b>Open Space Acres</b>
1	N to S	4	456	393	44	0	7	12
2	E to W	1	1,276	905	287	22	59	3
3	E to W	3	1,083	367	642	7	58	9
4	E to W	2	810	426	176	140	56	12
5	E to W	1	546	434	97	0	13	2
6	S & SE	1	695	475	125	0	73	17
7	to center	1	1,029	858	89	11	53	18
8	E to W	1	248	163	27	58	0	0
9	SW & NW	1	399	295	91	0	12	1
10	S & E	3	416	16	49	351	0	0
11	S & E	1	424	338	64	3	18	1
12	S & E	1	719	556	98	9	41	15
13	S & E	1	84	0	7	77	0	0
14	S & W	2	3,374	2,445	392	148	273	116
15	S & W	1	958	569	167	197	25	0
16	N to S	1	194	113	61	8	5	7
17	S & E	1	317	244	68	0	5	0
18	E	1	1,814	804	262	729	19	0
19	E	20	3,898	2,475	610	439	228	146
20	S & E	1	2,259	1,215	412	70	492	70
21	S & E	3	1,172	773	125	0	55	219
22	variable	9	520	38	428	0	54	0
23	S	1	213	110	85	0	14	4
24	SE & NW	1	281	188	30	0	0	63
25	W & E	2	90	70	9	0	4	7
26	S & W	3	355	304	22	0	29	0
27	E & S	9	1,083	825	109	0	143	6
28	S & E	1	630	386	179	0	65	0
29	S	8	727	633	10	0	26	58
30	SW(6) & SE(1)	7	546	508	19	0	19	0
<b>Total Acres</b>			26,616	16,926	4,784	2,269	1,846	786

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## **4.0 MONITORING PROGRAM**

### **4.1 Monitoring Program Objectives**

The stated long-term objectives of the stormwater monitoring program are as follows:

1. Estimate annual mass emissions of pollutants discharged to surface waters through the MS4;
2. Evaluate water column and sediment toxicity in receiving waters;
3. Evaluate impact of stormwater/urban runoff on marine life in receiving waters;
4. Determine and prioritize pollutants of concern in stormwater;
5. Identify pollutant sources on the basis of flow sampling, facility inspections, and ICID investigations; and
6. Evaluate BMP effectiveness.

The emphasis during the first three years of monitoring efforts has been directed towards characterizing the chemical and toxicological characteristics of discharges from the city's MS4 during both storm events and dry weather periods to develop the data needed address the first five objectives listed above. In addition, a start on BMP investigations through the special Parking Lot Study was implemented during the first full year of monitoring. Specific objectives of this year's work included the following:

1. Obtain monitoring data from four (4) storm events for each mass emission station during the 2002-2003 storm season.
2. Conduct a pilot program to document the extent of stormwater plumes in Alamitos Bay and measure associated toxicity and water chemistry at four different dilutions.
3. Carry out dry weather inspections and obtain samples of dry weather flow at each of the four mass emission stations. Perform this dry weather work twice during the dry season that extends from May through October.
4. Perform chemical analyses for the specified suite of analytes at the appropriate detection limits for all stormwater samples collected.
5. Perform toxicity testing of the stormwater samples collected, and Toxicity Identification Evaluations (TIEs) if warranted by the toxicity results at a given site.
6. Report the above results and evaluate the monitoring data with respect to receiving water quality criteria.

### **4.2 Monitoring Site Descriptions**

Four mass emission monitoring sites are routinely monitored as part of the City's stormwater program. The general locations of the drainage basins sampled by each of these sites and each monitoring location are shown in Figure 3.3. The latitude and longitude of each site are shown in Table 4.1. Brief descriptions of each drainage basin and land use are provided in the following sections. For more detailed descriptions including photographs and storm drain maps refer to previous annual reports (Kinnetic Laboratories, Inc. 2001 and 2002).

#### **4.2.1 Basin 14: Dominguez Gap Monitoring Site**

The sampling station located at the Dominguez Gap Pump Station is intended to monitor Basin 14 that covers 3,374 acres. Land use in this basin is 72% residential, 12% commercial, 8% institutional, 4% industrial, and 4% open space (Figure 4.1). The basin is located in the northwestern portion of Long

Beach just east of the Los Angeles River and is bounded on the north, south, east, and west by Artesia Boulevard, Roosevelt Road, the railroad, and the Los Angeles River respectively (City of Long Beach, 2001).

Normally in the summer, the retention basin located adjacent to the pump station would be dry according to the Flood Maintenance Division of the Los Angeles Public Works. However, current practice is to have the pumps locked off for the summer with water diverted into the retention basin from the Los Angeles River to recharge the groundwater aquifer and to study the feasibility of a wetland habitat in the area. During winter storms, the retention basin fills from stormwater discharge, which then infiltrates into the groundwater. During intense rains, when the retention basin fills to a specified level, the pump station pumps the water over the levee and discharges it into the Los Angeles River.

The stormwater monitoring equipment was located within the Dominguez Gap Pump Station. The automatic sampler utilized a peristaltic pump to collect water from the pump station's sump. The sampler was activated at the same set point (sump elevation) that activated the main discharge pumps, thus obtaining water samples during discharge to the Los Angeles River. Sump elevation was determined with a pressure transducer. Flow rates were determined from the individual pump curves of each pump, and total volume discharged was obtained by integrating this data over the period of time each pump discharged.

#### **4.2.2 Basin 20: Bouton Creek Monitoring Site**

This site collects water from Basin 20 covering 2,259 acres. Basin 20 is 54% residential, 22% institutional, 18% commercial, 3% industrial, and 3% open space (Figure 4.2). This basin is located in the east central portion of the City and is bounded on the north, south, east, and west by Spring Street, 8<sup>th</sup> Avenue, the Los Cerritos Channel and Redondo Avenue, respectively. The sampling station is located a short way upstream from the point of discharge into Los Cerritos Channel, along side of the Alamitos Maintenance Yard of the Los Angeles County Public Works Department.

At the sampling station, Bouton Creek is a 35 ft wide, 8.5 ft deep open concrete box channel. The elevation of the channel bed is approximately one inch lower at the side than the center. About a quarter of a mile to the southeast, Bouton Creek flows into Los Cerritos Channel. Based on numerous observations of conductivity at various tides, this site has saltwater influence at tide levels above three feet. The automatic sampling equipment was therefore configured and programmed to measure discharge flow and to obtain flow composited samples of the freshwater discharge down the creek, avoiding the tidal contributions by using real-time conductivity sensors. A velocity sensor was mounted on the invert of the box channel near the center of flow. Two conductivity sensors were mounted on the wall of the channel near the bottom and 2 feet above the bottom. A third conductivity sensor and the sample intake were mounted on a floating arm that kept them near the surface.

#### **4.2.3 Basin 23: Belmont Pump Station Monitoring Site**

This site collects water from Basin 23 that covers 213 acres. Land use in the basin is 52% residential, 40% commercial, 0% industrial, 6% institutional, and 2% open space (Figure 4.3). This basin is located in the southeastern portion of the City and is bounded on the north, south, east, and west by Colorado Street, Division Street, Ultimo Avenue and Belmont Avenue respectively. The Belmont Pump Station is located at 222 Claremont Avenue.

Water enters the forebay of the facility via a nine-foot diameter underground storm pipe. A trash rack catches debris before water drops four feet into the sump area. A single sump pump typically comes on

and discharges about two feet of water from the sump area every evening at around 2300 hours. Four main pumps are available to remove water during storm events. Water from these pumps is discharged into Alamitos Bay.

The stormwater monitoring equipment was located outside the pump station but on the grounds of the pump station inside a steel utility box. The sensors and sampling hose were installed inside the pump station sump adjacent to the large discharge pumps. The automatic sampler utilized a peristaltic pump to sample from the sump. The sampler was activated at the same set point (sump elevation) that activated the discharge pumps, thus obtaining water samples during the discharge to Alamitos Bay. Sump elevation was determined with a pressure transducer. Flow rates were determined from the individual pump curves of each pump, and total volume discharged obtained by integrating this data over the period of time each pump discharged.

#### **4.2.4 Basin 27: Los Cerritos Channel Monitoring Site**

Basin 27 is 1,083 acres and land use is 76% residential, 10% commercial, 13% institutional, and 1% open space (Figure 4.4). It is located in the east central portion of Long Beach and is bound on the north, south, east, and west by Spring Street, Rendina Street, the San Gabriel River, and Bellflower Boulevard, respectively.

The drainage pattern is to the east and south on the west side of the Los Cerritos Channel and to the west and south on the east side. There are eight major storm drain systems with a total of three major storm drain lines contributing runoff. All eight major systems discharge into the Los Cerritos Channel.

The stormwater monitoring station was installed in a steel utility box located on the west side of the channel south of Stearns Street. Flow sensors and sampling tubing was installed on the bottom of the large concrete lined channel. This sampling site is above tidewater on Los Cerritos Channel. Flow rates based upon flow velocity and channel dimensions are used to control the composite sampler, and to calculate total flow at the end of the storm event.

### **4.3 Monitoring Station Design and Configuration**

Each of the four land use stations monitored in Long Beach were equipped with Kinnetic Laboratories Automatic Sampling System (KLASS). Figure 4.5 illustrates the configuration of a typical KLASS. This system consists of several commercially available components that Kinnetic Laboratories has integrated and programmed into an efficient flow-based stormwater compositing sampler. The receiving water site was not equipped with a KLASS.

The integral components of this system consist of an acoustic Doppler flow meter or a pressure transducer, a data logger/controller module, cellular or landline telecommunications equipment, a rain gauge, and a peristaltic sampler. The system installed at Bouton Creek also incorporated several conductivity cells for distinguishing tidal flow from fresh water runoff.

The equipment was installed with intakes and sensors securely mounted, tubing and wires in conduits, and all above ground instruments protected within a security enclosure. Section 4.2 described how the equipment was placed at each station.

All materials used in the collection of stormwater samples and in contact with the samples met strict criteria in order to prevent any form of contamination of the sample. These materials must allow both

inorganic and organic trace toxicant analyses from the same sampler and composite bottle. Only the highest grade of borosilicate glass is suitable for both trace metal and organic analyses from the same composite sample bottle. Sample hoses were Teflon®.

All bottles and hoses were cleaned according to EPA-approved protocols consistent with approved methodology for analysis of stormwater samples (USEPA, 1983). These bottles and hoses were then evaluated through a blanking process to verify that the hoses and composite bottles were contamination-free and appropriately cleaned for analyses of both inorganic and organic constituents.

#### **4.4 Field Monitoring Procedures**

The following sections provide a summary of the field methods and procedures used to collect and process data for both the wet and dry weather surveys.

##### **4.4.1 Wet Weather Monitoring**

Stormwater runoff was collected using two primary methods. Composite sampling was conducted to collect water for both chemical analysis and toxicity testing. A few analytes such as bacteria must be sampled using grab sampling methods and thus reflect conditions only at the time of sampling. This season, wet weather monitoring also included a pilot study designed to investigate the spatial extent conducted in the receiving waters of Alamitos Bay. The following sections provide details of methods used for composite sampling, grab sampling and for the pilot receiving water study in Alamitos Bay.

###### **4.4.1.1 Composite Sample Collection**

A priority objective of the storm monitoring was to maximize the percent storm capture of the composite sample, while ensuring that the composite bottle collects enough water to support all the required analyses. This study required volumes of up to 70 liters of sample from each of the four land use sites to meet these analytical needs.

All aspects of the sampling events were continuously tracked from an office command and control center (Storm Control) located at our Santa Cruz laboratory. The status of each station was monitored through telecommunication links to each site. Station data were downloaded, and the stations were controlled and reprogrammed remotely. Weather information, including Doppler displays of rainfall for each area being monitored were also available on screen at the Storm Control center. In addition, Storm Control was in contact by cellular phone with the field crews.

When a storm was likely, all stations were made ready to sample. This preparation included entering the correct volume of runoff required for each sample aliquot ("Volume to Sample"), setting the automatic sampler and the data logger to sampling mode, pre-icing the composite sample bottle, and performing a general equipment inspection. A brief physical inspection of the equipment was made if possible to make certain that there were no obvious problems such as broken conduit, a kinked hose, or debris.

Once a storm event ended, the stations were shut down either on site or remotely by Storm Control. The station was left ready for the next storm event in case there was insufficient time for a maintenance visit between storms. Data were retrieved remotely via telecommunications from the data logger on a daily basis throughout the wet weather season.

All water samples were kept chilled (4°C) and were transferred to the analytical laboratories within holding times. Prior to sample shipping, sub-sampling from the composite container into sample containers was accomplished using protocol cleaned Teflon and silicone sub-sampling hoses and a peristaltic pump. Using a large magnetic stirrer, all composite water was first mixed together thoroughly and then continuously mixed while the sub-sampling took place. All sub-sampling took place at a staging area near Long Beach. Documentation accompanying samples to the laboratories included Chain of Custody forms, and Analysis Request forms (complete with detection limits).

#### **4.4.1.2 Grab Sampling**

During each storm event, grab samples for oil and grease, total recoverable petroleum hydrocarbons (TRPH), total and fecal coliform, enterococcus, and methyl tertiary butyl ether (MTBE) were collected. The timing of grab sampling efforts was often driven by the short holding times for the bacterial analyses. The ability to deliver samples to the microbiological laboratory within the 6-hour holding time was always a major consideration.

Except at the pump stations, all grab samples were taken near the center of flow as possible or at least in an area of sufficient velocity to ensure good mixing. At the Dominguez Gap sampling site, grabs were taken from the sump. At the Belmont pump station, grabs were taken at the point of discharge for the pumps. Some sites required the use of a pole to obtain the samples. Poles used were fitted with special bottle holders to secure the sampling containers. Care was taken not to overfill the sample containers for some of the containers contained preservative. For the MTBE samples, care was taken to assure that no air bubbles were trapped in the sample vial.

#### **4.4.1.3 Alamitos Bay Pilot Receiving Water Study**

This element of the stormwater monitoring program was initiated during the annual program review with Regional Board staff. The primary objectives of the pilot receiving water program were to:

- Define the general vertical and horizontal extent of stormwater in Alamitos Bay, Marine Stadium and Los Cerritos Channel.
- Evaluate toxicity and associated water quality characteristics of the stormwater plume.

Alamitos Bay, located approximately 10 miles southeast of Long Beach Harbor, is a 1 by  $\frac{3}{4}$  mile, multi-use harbor. The opening of the harbor is at the southeast corner. The center of the harbor is occupied by Naples Island, which effectively gives it the structure of a ring. The bay receives fresh water from a variety of sources, the largest being Cerritos Creek, which drains the Long Beach Area and regions further inland. The upper end of Marine Stadium also can receive significant stormwater discharge volumes from Colorado Lagoon.

This pilot program was intended to be conducted once during the early portion of the 2002/2003 wet-weather season. The study area included all of Alamitos Bay, Marine Stadium and the Los Cerritos Channel up to the first upstream bridge. The study was to target an event where total rainfall was expected to exceed 0.5 inches to provide higher probabilities of encountering suitable ranges of stormwater concentrations in the study area. Field sampling was to be initiated within 12 to 24 hours following the end of rainfall.

The first task of this field program was to roughly define the horizontal and vertical extent of the stormwater plume. This required rapid characterization of the plume by use of a towed YSI Multiparameter Sonde deployed from a boom off the side of KLI's research vessel, the *D.W. Hood*. For

establishing the horizontal extent of the plume, the sonde was towed at a depth of approximately 0.5 feet. Data from the Sonde was recorded on a portable computer. Sonde parameters included time, salinity, temperature, turbidity, pH and dissolved oxygen. A Garmin differential global positioning system (DGPS) unit was linked to a separate portable computer to record location and time and provide a real-time display of position. The Sonde and DGPS unit were synchronized to the nearest second to ensure concurrent locational data for all water quality data.

Occasional depth profiles were conducted in the plume to determine the depth of freshwater influence. Profiles were made to a depth of 10 feet with near surface data being recorded at six-inch depth intervals. After defining the halocline, recording depth intervals were increased to 1-foot. After establishing the general distribution of stormwater in receiving waters, sites were selected for collection of water samples based upon salinity. Four sites were selected to be representative of four different stormwater dilutions. To the extent practical, sites were intended to be selected from locations within the defined study area where receiving water salinities ranged from approximately 15 to 30 ppt.

The following table summarizes the target ranges of conditions to be sampled in the field. The target ranges were to provide a general framework and strategy for selection of sampling locations. This was intended to provide stormwater concentrations ranging from 12 to 56 percent. As anticipated, the actual ranges varied due to specific field conditions during the survey such as the general extent of the stormwater plume and characteristics of the vertical profiles of the plume.

<b>Receiving Water Station Designation</b>	<b>Salinity (ppt)</b>	<b>Est. % Stormwater</b>
RW-1	15	56
RW-2	20	41
RW-3	25	26
RW-4	30	12

Each receiving water sample was subjected to the sea urchin fertilization test. This is the only test that has been found to suggest potential for toxicity in the marine/estuarine receiving waters of Alamitos Bay. These samples were also analyzed for a subset of the analytes required for the stormwater monitoring program. Analytes were selected based upon previous results of toxicity testing and Toxicity Identification Evaluations (TIEs) conducted on the stormwater samples as well as general potential for toxicity. Chemical analyses of receiving water samples included total and dissolved trace metals (Cd, Cu, Ni, Pb and Zn), TSS, ammonia-N, pH, conductivity, salinity and organophosphate pesticides.

The data files from the YSI Sonde that contained time and water quality measurements, and from the Garmin DGPS that contained time and position data were merged by the time field. This combined data was entered into ArcInfo and contours based upon the point measured values of salinity were generated. The contours were plotted on a map of Alamitos Bay to show the salinity throughout the bay a few hours after the end of the strong rainfall.

#### **4.4.2 Dry Weather Sampling**

The NPDES Permit calls for two dry weather inspections and sampling events to be carried out during the summer dry weather period at each of the four mass emission stations as well as samples to be taken at the Alamitos Bay receiving water site.

Inspections at each site included whether water was present and whether this water was flowing or just ponded. At sites that were found not to have flowing water, inspections were done in the upstream drains to verify that flow was not occurring into the site. This situation was encountered again this year at the Dominguez Gap Pump station where remnants of water were still ponded in the basin in front of the pump station, but the storm drain discharges into this basin were dry.

When flowing water was present at one of these mass emission sites, then water quality measurements, flow estimates, and water samples were taken along with observations of site conditions. Flowing water was present and all measurements were taken at Bouton Creek, the Belmont Pump Station, and at Los Cerritos Channel. Temperature and conductivity were measured with an Orion Model 140 meter, pH with an Orion Model 250 meter, and oxygen was measured the Orion Model 840.

Water samples were collected at the Belmont Pump Station and the Los Cerritos Channel Station by use of an automatic peristaltic pump sampler that collected aliquots every half hour for a 24-hour period. For the Bouton Creek Station where tidal influences are present, a similar sample was collected over a 2-4 hour period of low tide in order to isolate sampling of just the fresh water discharge down the creek. Additional grab samples were taken just after the time-composited samples for MTBE, TPH, and bacteria. All samples were chilled to 4 °C and transported to the appropriate laboratory for analysis.

## **4.5 Laboratory Analyses**

The water quality constituents selected for this program were established based upon the requirements of the City of Long Beach NPDES permit for stormwater discharges. Analytical methods are based upon approved USEPA methodology. The following sections detail laboratory methods for chemical and biological testing.

### **4.5.1 Analytical Suite and Methods**

Conventional, bacteriological, and chemical constituents selected for inclusion in this stormwater quality program are presented in Table 4.2. Analytical method numbers, holding times, and reporting limits are also indicated for each analysis. Semivolatile organic compounds listed in the table apply only to the September 2002 dry weather monitoring event as these constituents were not required as part of the 2002/2003 monitoring program.

#### **4.5.1.1 Laboratory QA/QC**

Quality Assurance/ Quality Control (QA/QC) activities associated with laboratory analyses are detailed in Appendix A.

The laboratory QA/QC activities provide information needed to assess potential laboratory contamination, analytical precision and accuracy, and representativeness. Analytical quality assurance for this program included the following:

- Employing analytical chemists trained in the procedures to be followed.
- Adherence to documented procedures, USEPA methods and written SOPs.
- Calibration of analytical instruments.
- Use of quality control samples, internal standards, surrogates and SRMs.
- Complete documentation of sample tracking and analysis.

Internal laboratory quality control checks included the use of internal standards, method blanks, matrix spike/spike duplicates, duplicates, laboratory control spikes and Standard Reference Materials (SRMs).

Data validation was performed in accordance with the National Functional Guidelines for Organic Data Review (EPA540/R-94/012), Inorganic Data Review (EPA540/R-94/013), and Guidance on the Documentation and Evaluation of Trace Metals Data Collected for the Clean Water Act Compliance Monitoring (EPA/821/B/95/002).

#### **4.5.2 Toxicity Testing Procedures**

Upon receipt in the laboratory, stormwater discharge and receiving water samples were stored at 4 °C, in the dark until used in toxicity testing. Toxicity testing commenced within 72 hours of sample collection for most samples (Appendix Table A2-2). The relative toxicity of each discharge sample was evaluated using three chronic test methods: the water flea (*Ceriodaphnia dubia*) reproduction and survival test (freshwater), the purple sea urchin (*Strongylocentrotus purpuratus*) fertilization test (marine), and the mysid (*Americamysis bahia*) growth and survival test (marine). ToxScan, Inc. conducted the freshwater toxicity tests using the water flea, *Ceriodaphnia dubia*. Marine toxicity tests used the purple sea urchin (*Strongylocentrotus purpuratus*) and the mysid (*Americamysis bahia*). Tests using the mysid were limited to the first event of the season. Each of the methods is recommended by the USEPA for the measurement of effluent and receiving water toxicity. Water samples were diluted with laboratory water to produce a concentration series using procedures specific to each test method.

##### **4.5.2.1 Water Flea Reproduction and Survival Test**

Toxicity tests using the water flea, *Ceriodaphnia dubia*, were conducted in accordance with methods recommended by USEPA (1994a). The test procedure consisted of exposing 10 *C. dubia* neonates (less than 24 hours old) to the samples for six days. One animal was placed in each of 10 individual polystyrene cups containing approximately 20 mL of test solution. The test temperature was  $25 \pm 1$  °C and the photoperiod was 16 hours light: 8 hours dark. Daily water changes were accomplished by transferring each individual to a fresh cup of test solution; water quality measurements and observations of survival and reproduction (number of offspring) were made at this time also. Prior to transfer, each cup was inoculated with food (100 µL of a 3:1 mixture of *Selenastrum* culture, density approximately  $3.5 \times 10^8$  cells/mL, and *Ceriodaphnia* chow).

The test organisms were obtained from in-house cultures that were established from broodstock obtained from USEPA (Duluth, MN). The laboratory water used for cultures, controls, and preparation of sample dilutions was synthetic moderately hard freshwater, prepared with deionized water and reagent chemicals. Test samples were poured through a 60 µm Nitex screen in order to remove indigenous organisms prior to preparation of the test concentrations. Serial dilutions of the test sample were prepared, resulting in test concentrations of 100, 50, 25, 12, and 6 %.

The quality assurance program for this test consisted of three components. First, a control sample (laboratory water) was included in all tests in order to document the health of the test organisms. Second, a reference toxicant test consisting of a concentration series of potassium chloride (KCl) was conducted with each batch of samples to evaluate test sensitivity and precision. Third, the results were compared to established performance criteria for control survival, reproduction, reference toxicant sensitivity, sample storage, and test conditions. Any deviations from the performance criteria were noted in the laboratory records and prompted corrective action, ranging from a repeat of the test to adjustment of laboratory equipment.

#### 4.5.2.2 Mysid Growth and Survival Test

Samples of wet weather discharge and receiving water were assessed for chronic toxicity using the marine mysid, *Americamysis bahia* (formerly named *Mysidopsis bahia*). Test procedures followed the guidelines established by USEPA (1994b). The procedure consisted of a seven-day exposure of juvenile (7 day old) mysids to the samples. Eight replicate test chambers (250 mL beakers), each containing five mysids, were tested for each concentration. The beakers contained 150 mL of test solution, which was changed daily. The test temperature was  $26 \pm 1$  °C and the photoperiod was 16 hours light: 8 hours dark. Water quality and mysid survival measurements were recorded during each water change. Mysids were fed a standardized amount of newly hatched brine shrimp twice daily. At the end of the test, the surviving animals were dried and weighed to the nearest 0.001 mg to determine effects on growth.

The discharge water samples were adjusted to a salinity of 30 g/kg before testing. This was accomplished by adding a sea salt mixture (TropicMarin™) to the samples. The addition of sea salts was carried out the day before a test was initiated. The receiving water samples from Alamitos Bay had salinities greater than 30 g/kg and were tested without adjustment of the salinity. The salinity-adjusted samples were then diluted with seawater to produce test concentrations of 100, 50, 25, 12, and 6%. The test organisms were lab-reared *A. bahia* that were purchased from a commercial supplier. For most of the tests, the animals were received the day before the test started and were acclimated to the test temperature and salinity overnight.

Negative control (1.0 µm and activated carbon filtered natural seawater from ToxScan's Marine Bioassay facility at Long Marine Laboratory in Santa Cruz was diluted to 30 g/kg with deionized water) and sea salt control samples (deionized water mixed with sea salts) were included in each test series for quality control purposes. In addition, a reference toxicant test was included with each batch of test samples. Each reference toxicant test consisted of a concentration series of copper chloride with eight replicates tested per concentration. The median lethal concentration (LC50) was calculated from the data and compared to control limits based upon the cumulative mean and two standard deviations from recent experiments. Control and water quality data were also compared to established performance objectives; any deviations from these were noted and corrected, if possible.

#### 4.5.2.3 Sea Urchin Fertilization Test

All discharge and receiving water samples of stormwater were also evaluated for toxicity using the purple sea urchin fertilization test (USEPA 1995). This test measures toxic effects on sea urchin sperm, which are expressed as a reduction in their ability to fertilize eggs. The test consisted of a 20-minute exposure of sperm to the samples. Eggs were then added and given 20 minutes for fertilization to occur. The eggs were then preserved and examined later with a microscope to assess the percentage of successful fertilization. Toxic effects are expressed as a reduction in fertilization percentage. Purple sea urchins (*Strongylocentrotus purpuratus*) used in the tests were supplied by U.C. Davis – Granite Canyon. The tests were conducted in glass shell vials containing 10 mL of solution at a temperature of  $15 \pm 1$  °C. Five replicates were tested at each sample concentration.

All samples were adjusted to a salinity of 33.5 g/kg for the fertilization test. Previous experience has determined that many sea salt mixes are toxic to sea urchin sperm. Therefore, the salinity for the urchin test was adjusted by the addition of hypersaline brine. The brine was prepared by freezing and partially thawing seawater. Since the addition of brine dilutes the sample, the highest stormwater concentration that could be tested for the sperm cell test was 50%. The adjusted samples were diluted with seawater to produce test concentrations of 50, 25, 12, 6, and 3%.

Seawater control (1.0 µm filtered natural seawater from ToxScan's Long Marine Laboratory facility) and brine control samples (50% deionized water and 50% brine) were included in each test series for quality

control purposes. Water quality parameters (temperature, dissolved oxygen, pH, ammonia, and salinity) were measured on the test samples to ensure that the experimental conditions were within desired ranges and did not create unintended stress on the test organisms. In addition, a reference toxicant test was included with each stormwater test series in order to document intralaboratory variability. Each reference toxicant test consisted of a concentration series of copper sulfate with four replicates tested per concentration. The median effective concentration (EC50) was estimated from the data and compared to control limits based upon the cumulative mean and two standard deviations of recent experiments.

#### 4.5.2.4 Toxicity Identification Evaluations (TIEs)

Phase I TIEs were conducted on selected runoff samples from stations that exhibited substantial ( $\geq 2$  TU<sub>ec</sub>) toxicity, in order to determine the characteristics of the toxicants present. Each sample was subjected to treatments designed to selectively remove or neutralize classes of compounds (e.g., metals, nonpolar organics) and thus the toxicity that may be associated with them. Treated samples were then tested to determine the change in toxicity using the sea urchin fertilization test.

Four or five treatments were applied to each sample. These treatments were: particle removal, trace metal chelation, nonpolar organic extraction, organophosphate (OP) deactivation (except urchins) and chemical reduction. With the exception of the organics extraction, each treatment was applied independently on a salinity-adjusted sample. A control sample (lab dilution water) was included with each type of treatment to verify that the manipulation itself was not causing toxicity. If the TIE was not conducted concurrently with the initial testing of a sample, then a reduced set of concentrations of untreated sample was tested at the time of the TIE to determine the baseline toxicity and control for changes in toxicity due to sample storage.

Ethylene diamine tetraacetic acid (EDTA), a chelator of metals, was added to a concentration of 60 mg/L to the marine test samples. EDTA additions to the *Ceriodaphnia* samples were based upon sample hardness (USEPA 1991). Sodium thiosulfate (STS), a treatment that reduces oxidants such as chlorine and also decreases the toxicity of some metals was added to a concentration of 50 mg/L to separate portions of each marine sample. STS additions to the *Ceriodaphnia* samples were at 500, 250 and 125 mg/L. The EDTA and sodium thiosulfate treatments were given at least one hour to interact with the sample prior to the start of toxicity testing. Pipernyl butoxide, which inhibits activation of OP pesticides was added to a concentration of 100 mg/L for mysids and at three concentrations (125, 250 and 500 mg/L) for *Ceriodaphnia*.

Samples were centrifuged for 30 min at 3000 X g to remove particle-borne contaminants and tested for toxicity. A portion of the centrifuged sample was also passed through a 360 mg Sep-Pak™ C18 solid phase extraction column in order to remove nonpolar organic compounds. C18 columns have also been found to remove some metals from aqueous solutions.

#### 4.5.2.5 Statistical Analysis

The toxicity test results were normalized to the control response in order to facilitate comparisons of toxicity between experiments. Normalization was accomplished by expressing the test responses as a percentage of the control value. Four statistical parameters (NOEC, LOEC, median effect, and TUc) were calculated to describe the magnitude of stormwater toxicity. The NOEC (highest test concentration not producing a statistically significant reduction in fertilization or survival) and LOEC (lowest test concentration producing a statistically significant reduction in fertilization or survival) were calculated by comparing the response at each concentration to the dilution water control. Various statistical tests were used to make this comparison, depending upon the characteristics of the data. Water flea survival and reproduction data were usually tested against the control using Fisher's Exact and Steel's Many-One Rank test, respectively. Sea urchin fertilization and mysid survival data were evaluated for significant

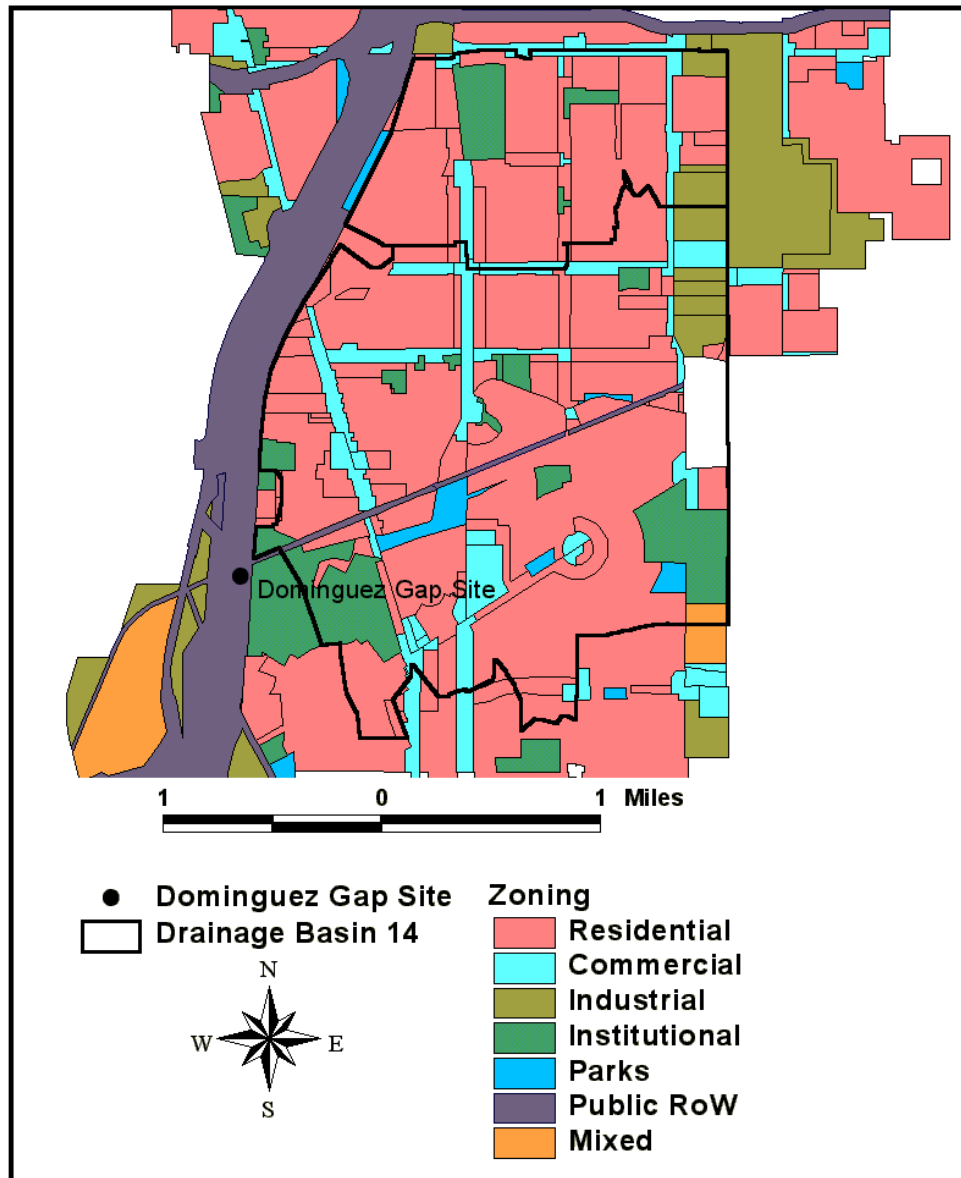
differences using Dunnett's multiple comparison test, provided that the data met criteria for homogeneity of variance and normal distribution. Data that did not meet these criteria were analyzed by the non-parametric Steel's Many-One Rank or Wilcoxon's tests.

Measures of median effect for each test were calculated as the LC50 (concentration producing a 50% reduction in survival) for mysid and water flea survival, the EC50 (concentration effective on 50% of eggs) for sea urchin fertilization, or the IC50 (concentration inhibitory to 50% of individuals) for water flea reproduction and IC25 for mysid growth. The LC50 or EC50 was calculated using either probit analysis or the trimmed Spearman-Kärber method. The IC25 and IC50 were calculated using linear interpolation analysis. All procedures for calculation of median effects followed USEPA guidelines.

The toxicity results were also expressed as chronic Toxic Units (TUC). This statistic was calculated as:  $100/\text{NOEC}$ . Increased values of toxic units indicate relatively greater toxicity, whereas greater toxicity for the NOEC, LOEC, and median effect statistics is indicated by a lower value.

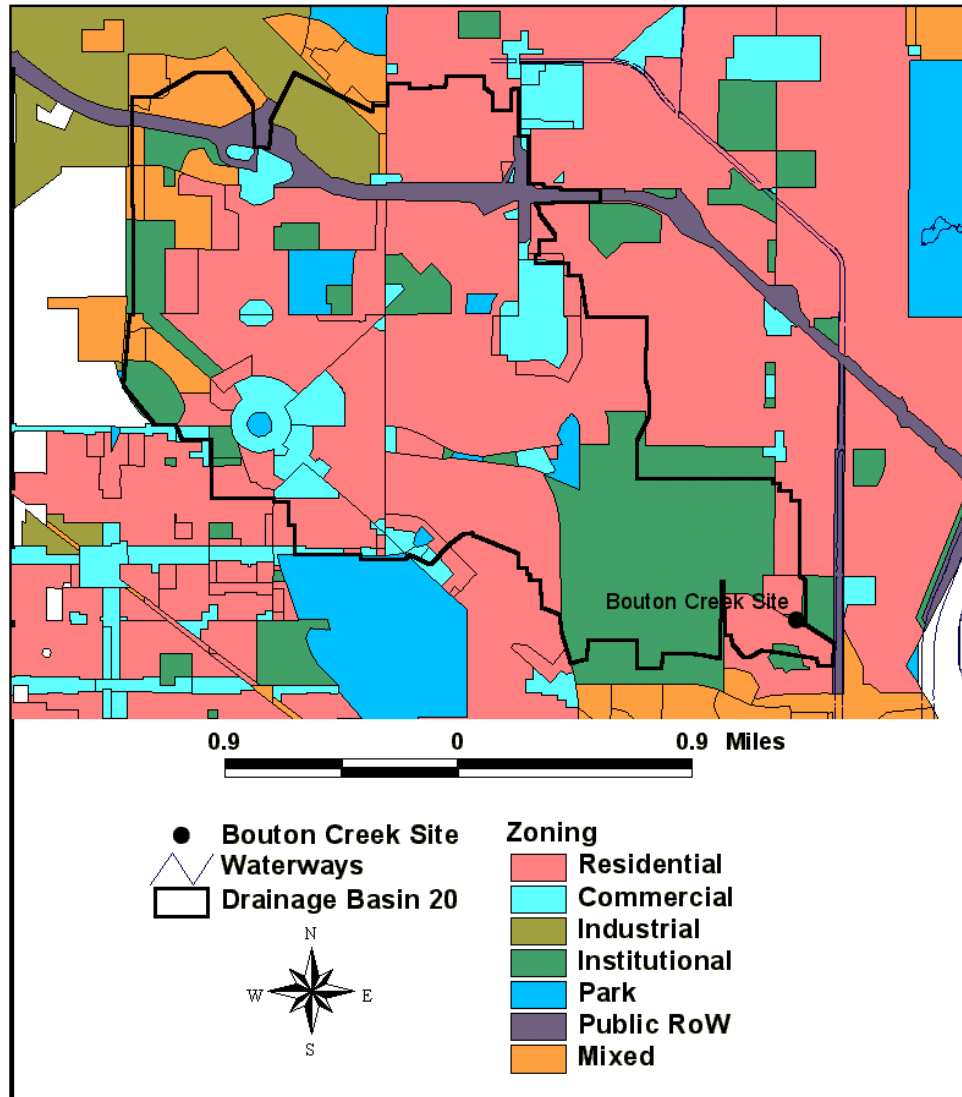
Comparisons of chemical or physical parameters with toxicity results were made using the non-parametric Spearman rank order correlation.

## Land Use of Drainage Basin 14



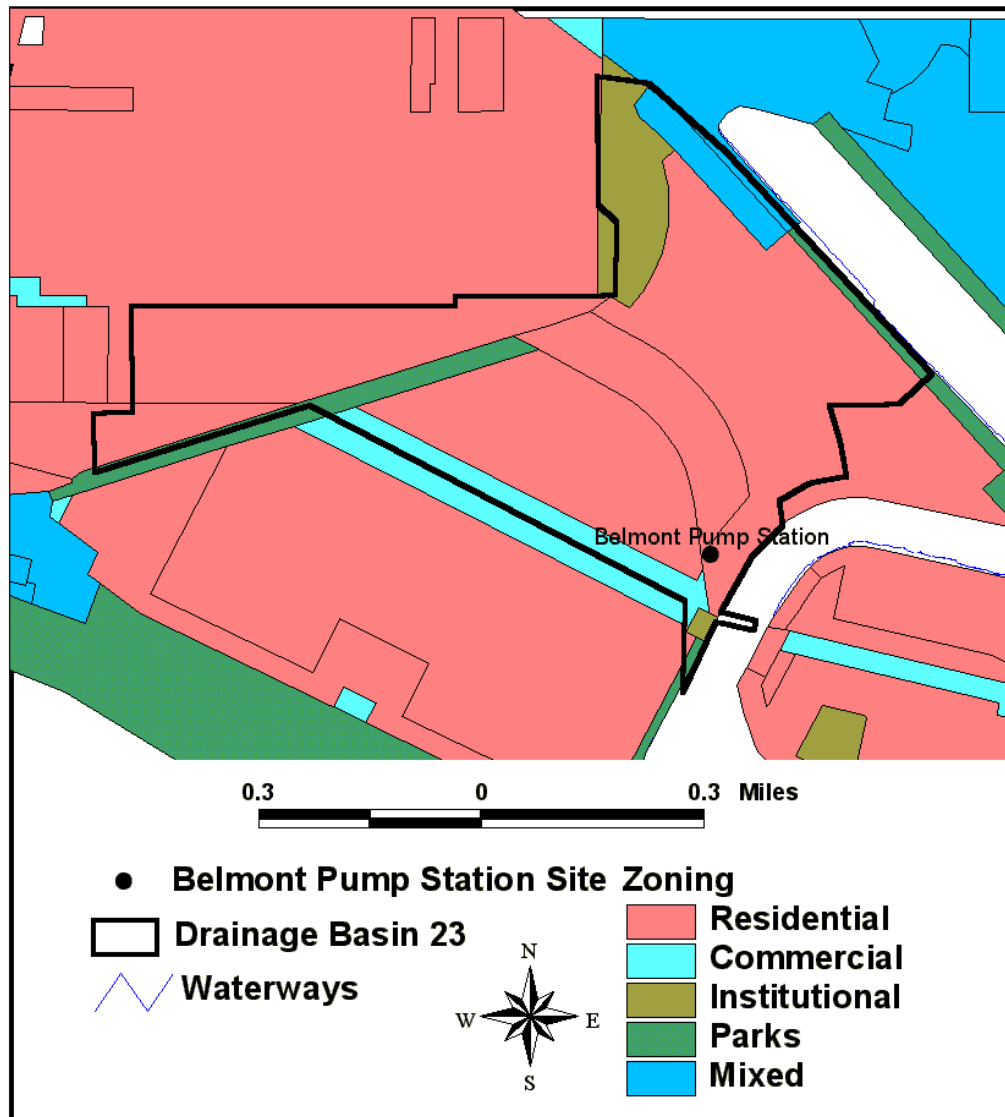
**Figure 4.1** Land Use of Drainage Basin #14 which Drains to the Dominguez Gap Mass Emissions Site (Source: City of Long Beach Department of Technology Services, last update 12/20/00).

## Land Use of Drainage Basin 20



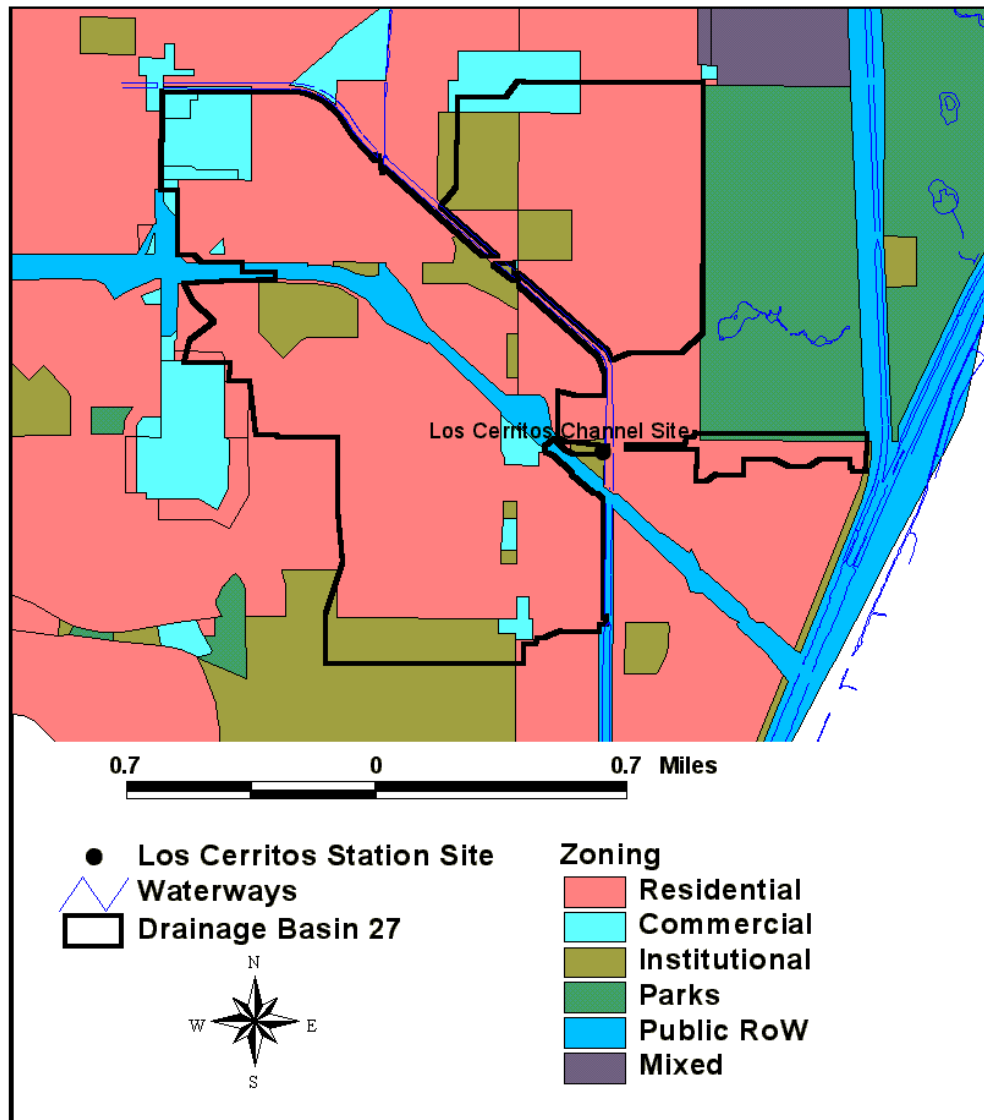
**Figure 4.2** Land Use of Drainage Basin #20 which drains to the Bouton Creek Mass Emissions Site (Source: City of Long Beach, Department of Technology Services, last updated 12/20/00).

## Land Use of Drainage Basin 23



**Figure 4.3** Land Use of Drainage Basin #23 which Drains to the Belmont Pump Station Mass Emissions Site (Source: City of Long Beach, Department of Technology Services, last updated 12/20/00)

## Land Use of Drainage Basin 27



**Figure 4.4** Land Use of Drainage Basin #27 which Drains to the Los Cerritos Channel Monitoring Site (Source: City of Long Beach, Department of Technology Services, last update 12/20/00).

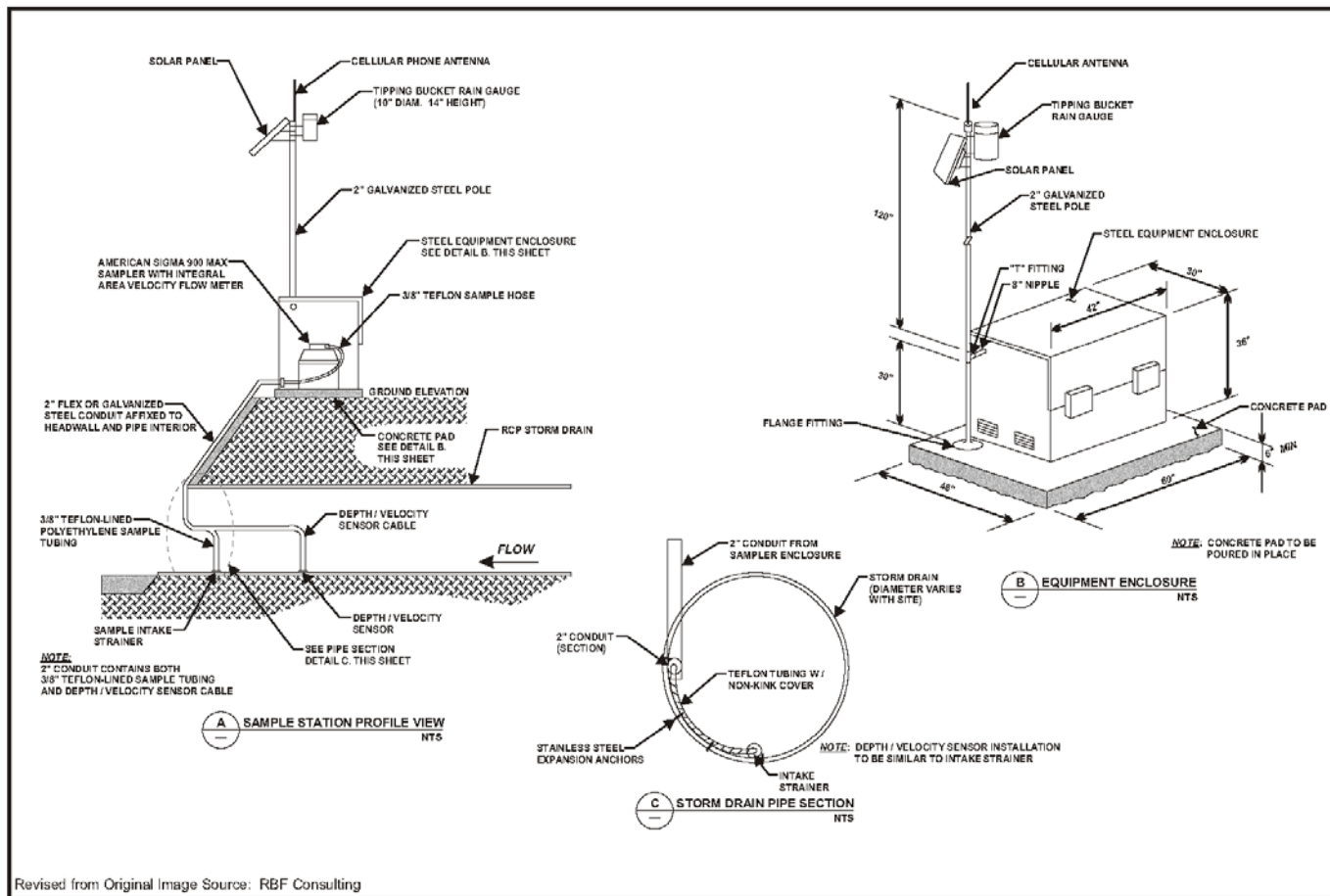


Figure 4.5 Typical KCLASS Stormwater Monitoring Station.

**Table 4.1 Location Coordinates of Monitoring Stations for the City of Long Beach Stormwater Monitoring Program.**

<b>Station Name</b>	<b><u>State Plane Coordinates: Zone 5</u></b>		<b><u>North American Datum (NAD) 83</u></b>	
	<b>Northing (ft)</b>	<b>Easting (ft)</b>	<b>Latitude</b>	<b>Longitude</b>
Belmont Pump	1734834.9	6522091.2	33° 45' 36.6"N	118° 07' 48.7"W
Bouton Creek	1741960.5	6529305.2	33° 46' 44.3"N	118° 06' 23.4"W
Cerritos Channel	1747935.9	6530153.2	33° 47' 43.3"N	118° 06' 13.4"W
Dominguez Gap	1764025.0	6500042.5	33° 50' 22.1"N	118° 12' 10.5"W

**Table 4.2 Analytical Methods, Holding Times, and Reporting Limits.**

Analyte and Reporting Unit	EPA Method Number	Holding Time	Target Reporting Limit or ML
<b>CONVENTIONAL PARAMETERS</b>			
Oil and Grease (mg/L)	1664	28 days	5.0
Total Phenols (mg/L)	420.1	28 days	0.1
Cyanide (µg/L)	335.2	14 days	0.005
pH (units)	150.1	ASAP	0 – 14
Dissolved Phosphorus (mg/L)	365.3	48 hours	0.01
Total Phosphorus (mg/L)	365.3	28 days	0.05
Turbidity (NTU)	180.1	48 hours	1.0
Total Suspended Solids (mg/L)	160.2	7 days	1.0
Total Dissolved Solids (mg/L)	160.1	7 days	1.0
Volatile Suspended Solids (mg/L)	160.4	7 days	1.0
Total Organic Carbon (mg/L)	415.1	28 days	1.0
Total Recoverable Petroleum Hydrocarbon (mg/L)	1664	28 days	5.0
Biochemical Oxygen Demand (mg/L)	405.1	48 hours	4.0
Chemical Oxygen Demand (mg/L)	410.1	28 days	4.0
Total Ammonia-Nitrogen (mg/L)	350.2	28 days	0.1
Total Kjeldahl Nitrogen (mg/L)	351.3	28 days	0.1
Nitrite Nitrogen (mg/L)	300.0	48 hours	0.1
Nitrate Nitrogen (mg/L)	300.0	48 hours	0.1
Alkalinity, as CaCO <sub>3</sub> (mg/L)	310.1	48 hours	5.0
Specific Conductance (µmhos/cm)	120.1	48 hours	1.0
Total Hardness (mg/L)	130.2	180 days	1.0
MBAS (mg/L)	425.1	48 hours	0.02
Chloride (mg/L)	300.0	48 hours	1.0
Fluoride (mg/L)	300.0	48 hours	0.1
Methyl tertiary butyl ether (MTBE) (µg/L)	8020A/8260	14 days	0.5
<b>BACTERIA (MPN/100ml)</b>			
Total Coliform	SM 9221B	6 hours	<20
Fecal Coliform	SM 9221B	6 hours	<20
Enterococcus	SM 9230C	6 hours	<20
<b>TOTAL AND DISSOLVED METALS (µg/L)<sup>1</sup></b>			
Aluminum	200.8	180 days	25
Antimony	200.8	180 days	0.5
Arsenic	200.8	180 days	0.5
Beryllium	200.8	180 days	0.5
Cadmium	200.8	180 days	0.25
Chromium	200.8	180 days	0.5
Copper	200.8	180 days	0.5
Hexavalent Chromium (total)	SM 3500D	24 hours	0.3-20
Iron	236.1	180 days	25
Lead	200.8	180 days	0.5
Mercury	245.7	28 days	0.2
Nickel	200.8	180 days	1.0
Selenium	200.8	180 days	1.0
Silver	200.8	180 days	0.25
Thallium	200.8	180 days	1.0
Zinc	200.8	180 days	1.0

1. Samples to be analyzed for dissolved metals are to be filtered within 48 hours.

**Table 4.2 Analytical Methods, Holding Times, and Reporting Limits. (continued)**

Analyte and Reporting Unit	EPA Method Number	Holding Time	Target Reporting Limit
<b>CHLORINATED PESTICIDES (µg/L)</b>			
Aldrin	8081A	7 days	0.005
alpha-BHC	8081A	7 days	0.01
beta-BHC	8081A	7 days	0.005
delta-BHC	8081A	7 days	0.005
gamma-BHC (lindane)	8081A	7 days	0.02
alpha-Chlordane	8081A	7 days	0.1
gamma-Chlordane	8081A	7 days	0.1
4,4'-DDD	8081A	7 days	0.05
4,4'-DDE	8081A	7 days	0.05
4,4'-DDT	8081A	7 days	0.01
Dieldrin	8081A	7 days	0.01
Endosulfan I	8081A	7 days	0.02
Endosulfan II	8081A	7 days	0.01
Endosulfan sulfate	8081A	7 days	0.05
Endrin	8081A	7 days	0.01
Endrin Aldehyde	8081A	7 days	0.01
Heptachlor	8081A	7 days	0.01
Heptachlor Epoxide	8081A	7 days	0.01
Toxaphene	8081A	7 days	0.5
<b>AROCLORS (µg/L)</b>			
Aroclor-1016	8081A	7 days	0.5
Aroclor-1221	8081A	7 days	0.5
Aroclor-1232	8081A	7 days	0.5
Aroclor-1242	8081A	7 days	0.5
Aroclor-1248	8081A	7 days	0.5
Aroclor-1254	8081A	7 days	0.5
Aroclor-1260	8081A	7 days	0.5
Total PCBs	8081A	7 days	0.5
<b>ORGANOPHOSPHATE PESTICIDES (µg/L)</b>			
Diazinon	8141A	7 days	0.01
Chlorpyrifos (Dursban)	8141A	7 days	0.05
Malathion	8141A	7 days	1.0
Prometryn	8141A	7 days	1.0
Atrazine	8141A	7 days	1.0
Simazine	8141A	7 days	1.0
Cyanazine	8141A	7 days	1.0
<b>HERBICIDES (µg/L)</b>			
2,4-D	8151A	7 days	1.0
2,4,5-TP-Silvex	8151A	7 days	0.50
Glyphosate	547	14 days	5.0

**Table 4.2 Analytical Methods, Holding Times, and Reporting Limits. (continued)**

Analyte and Reporting Unit	EPA Method Number	Holding Time	Target Reporting Limit
<b>SEMIVOLATILE ORGANIC COMPOUNDS (µg/L)</b>			
Acenaphthene	625	7 days	1.0
Acenaphthylene	625	7 days	1.0
Anthracene	625	7 days	1.0
Benzidine	625	7 days	1.0
Benzo(a)anthracene	625	7 days	1.0
Benzo(b)fluoranthene	625	7 days	1.0
Benzo(k)fluoranthene	625	7 days	1.0
Benzo(g,h,i)perylene	625	7 days	1.0
Benzo(a)pyrene	625	7 days	1.0
Benzyl butyl phthalate	625	7 days	1.0
Bis(2-chloroethyl)ether	625	7 days	1.0
Bis(2-chloroethoxy)methane	625	7 days	2.0
Bis(2-ethylhexyl)phthalate	625	7 days	1.0
Bis(2-chlorisopropyl)ether	625	7 days	1.0
4-Bromophenyl phenyl ether	625	7 days	1.0
2-Chloroethyl vinyl ether	625	7 days	-
2-Chloronaphthalene	625	7 days	1.0
4-Chlorophenyl phenyl ether	625	7 days	1.0
Chrysene	625	7 days	1.0
Dibenzo(a,h)anthracene	625	7 days	1.0
1,3-Dichlorobenzene	625	7 days	1.0
1,2-Dichlorobenzene	625	7 days	1.0
1,4-Dichlorobenzene	625	7 days	1.0
3,3-Dichlorobenzidine	625	7 days	1.0
Diethylphthalate	625	7 days	1.0
Dimethylphthalate	625	7 days	1.0
Di-n-Butyl phthalate	625	7 days	1.0
2,4-Dinitrotoluene	625	7 days	1.0
2,6-Dinitrotoluene	625	7 days	1.0
4,6 Dinitro-2-methylphenol	625	7 days	2.0
1,2-Diphenylhydrazine	625	7 days	1.0
Di-n-Octyl phthalate	625	7 days	1.0
Fluoranthene	625	7 days	1.0
Fluorene	625	7 days	1.0
Hexachlorobenzene	625	7 days	1.0
Hexachlorobutadiene	625	7 days	1.0
Hexachloro-cyclopentadiene	625	7 days	1.0
Hexachloroethane	625	7 days	1.0
Indeno[1,2,3-cd]pyrene	625	7 days	1.0
Isophorone	625	7 days	1.0
Naphthalene	625	7 days	1.0
Nitrobenzene	625	7 days	1.0
N-Nitroso-dimethyl amine	625	7 days	-
N-Nitroso-diphenyl amine	625	7 days	1.0
N-Nitroso-di-n-propyl amine	625	7 days	5.0

**Table 4.2 Analytical Methods, Holding Times, and Reporting Limits. (continued)**

Analyte and Reporting Unit	EPA Method Number	Holding Time	Target Reporting Limit
<b>SEMIVOLATILE ORGANIC COMPOUNDS (µg/L) (continued)</b>			
Phenanthrene	625	7 days	1.0
Pyrene	625	7 days	1.0
1,2,4-Trichlorobenzene	625	7 days	1.0
4-Chloro-3-methylphenol	625	7 days	1.0
2-Chlorophenol	625	7 days	2.0
2,4-Dichlorophenol	625	7 days	2.0
2,4-Dimethylphenol	625	7 days	1.0
2,4-Dinitrophenol	625	7 days	5.0
2-Nitrophenol	625	7 days	1.0
4-Nitrophenol	625	7 days	1.0
Pentachlorophenol	625	7 days	1.0
Phenol	625	7 days	1.0
2,4,6-Trichlorophenol	625	7 days	1.0

SM = Method number from *Standard Methods for the Examination of Water and Wastewater* (APHA 1995).

1. Samples must be filtered within 48 hours.

- indicates analyte not reported.

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## **5.0 RAINFALL AND HYDROLOGY**

All Long Beach monitoring stations were fully operational during the 2002/2003 wet weather season. Precipitation and discharge were continuously monitored throughout the season. The first two major storm events of the season were captured at three of the stations including the Belmont Pump Station, Los Cerritos Creek and Bouton Creek. Neither of the events were sufficient to produce a discharge at the Dominguez Gap Pump Station. As required by the NPDES permit, four events were sampled at Belmont Pump Station, Los Cerritos Creek and Bouton Creek. Only three events were monitored at Dominguez Gap Pump Station since this site did not discharge until late in the season following a series of events where runoff volumes finally exceeded infiltration capacity of the basin to cause discharge of stormwater from this station. All discharge events at the Dominguez Gap Pump Station site were sampled during this monitoring year.

### **5.1 Precipitation during the 2002/2003 Storm Season**

Precipitation during the 2002/2003 water year was slightly below normal in Long Beach according to the National Weather Service climate station at Long Beach Daugherty Airport (Figure 5.1) but well above levels from the previous year. During the prior season, only 1.99 inches of rain was recorded at the Long Beach Airport from October 2001 to April 2002. This season, a total of 8.62 inches of rainfall was recorded at the airport during this time period. Normal precipitation for October through April at the Long Beach Airport is 12.27 inches.

Rainfall was relatively uniform at each of the monitoring stations with seasonal totals ranging from 11.13 inches at the Dominguez Pump Station to 12.11 inches at the Los Cerritos Creek stormwater monitoring site.

#### **5.1.1 Monthly Precipitation**

Normal rainfall during January averages nearly three inches making it one of the wettest months of the storm season (Figure 5.1) in Long Beach. During January 2003 no rainfall was measured at the Long Beach Airport or any of the stormwater monitoring stations. This lack of rain was made up for by an above normal February, which had 4.40 inches of rain. The combined rainfall for January and February 2003 was 4.40 inches, nearly 74 percent of the normal for those two months.

#### **5.1.2 Precipitation during Monitored Events**

Precipitation during each storm event was characterized by total rainfall, duration of rainfall, maximum intensity, days since last rainfall, and the magnitude of the event immediately preceding the monitored storm event (antecedent rainfall). Precipitation characteristics for each event are summarized in Table 5.1 and resulting flow in Table 5.2. Cumulative descriptive statistics for the season at each monitoring station are presented in Table 5.3. Cumulative rainfall and intensity are summarized graphically for each monitored event at each station in Figures 5.2 through 5.16.

Total rainfall measured during each of the five monitored events in the 2002/2003 wet season varied from 0.99 to 2.70 inches. The third event was the largest with an average rainfall among sampling stations of 2.70 inches and the fourth event was the smallest with an average rainfall of 0.99 inches. All rainfall monitored during the 2002/2003 storm season was above normal for single events. The mean rainfall amount for all monitored events ranged from 1.43 inches at the Belmont Pump Station to 1.89 inches at the Dominguez Gap Pump Station.

Maximum rainfall intensities were particularly impressive during the 2002/2003 storm season. The mean maximum rainfall intensities among monitored events ranged from 0.72 inches per hour at Bouton Creek to 0.92 inches per hour at the Dominguez Gap Pump Station.

Except for Event 4 on 24 February 2003 at the Belmont Pump Station, all storm events monitored were spaced by at least 5 days of no antecedent rainfall. The fourth event at Belmont Pump Station was preceded by 0.12 inches of rainfall 0.4 days earlier. The 51 days preceding the third event on February 11, 2003 was the driest period prior to a monitored event. Overall the mean period of dry conditions between monitored events ranged from 23.2 days at Dominguez Gap Pump Station to 49.7 days at Los Cerritos Creek.

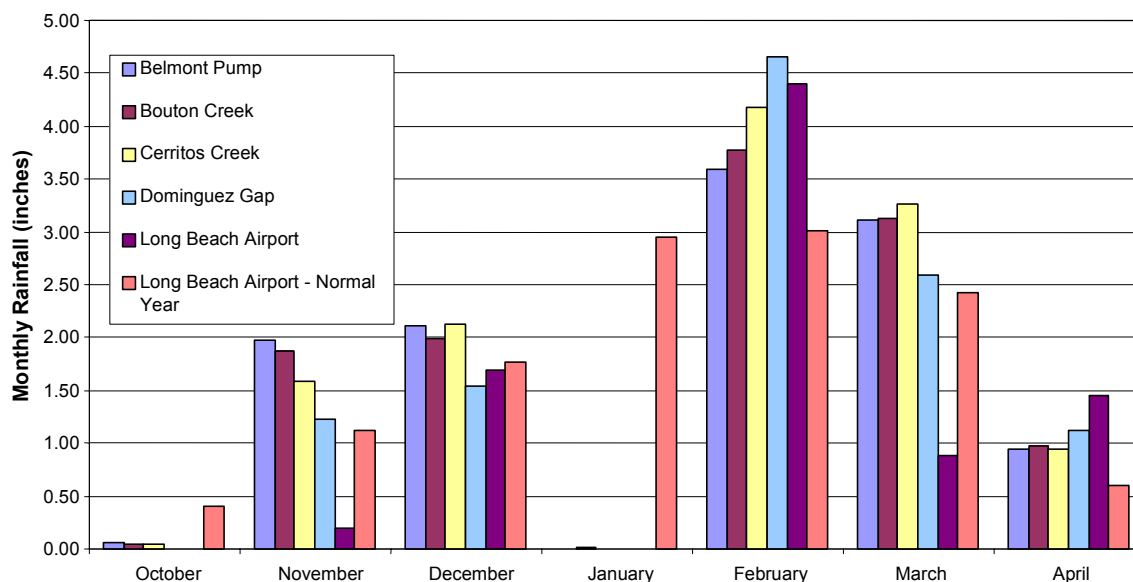
## **5.2 Stormwater Runoff during Monitored Events**

Monitoring was designed to isolate rainfall events and the runoff created by those events. Table 5.2 summarizes flow characteristics among monitored events at each station. Table 5.3 provides descriptive statistics for all monitored events since the beginning of the 2002/2003 season. This information complements Event Mean Concentration (EMC) statistics for each monitored analyte at these sites. Figures 5.2 through 5.16 graphically depict flow during each monitored event at each station in response to rainfall. These figures also show how the aliquoting of each composite sample was conducted.

There was high variability between the stations in duration of flow during each event. Flow duration was typically greatest at Bouton Creek due to tidal effects. During incoming tides, low flows are backed up and held back by the tide. As the tide recedes, stormwater is detected at the station and sampling continues. This effect was most notable during the first and third events (Figure 5.3 and 5.9). Los Cerritos Creek also had long flow durations, and during Event 2 it had an extremely high total flow volume in a short amount of time. The station briefly exceeded the maximum rated stage causing a failure in the sampling strategy. Since the sampling was halted when the flow rating was exceeded, only a first flush sample was collected representing the rising hydrograph and approximately the first 20 percent of the runoff. Normally, this sample would have been discarded. However, since receiving water samples were collected in Los Alamitos Bay during this event and the sample represented a worst case situation, the sample was retained for comparative purposes.

The percent storm captures (percentage of the total storm event volume effectively represented by the flow-weighted composite sample) were acceptable in most cases. The storm capture at the Los Cerritos Creek Station during Event 2 was low due to the circumstances described above and the extreme intensity of rainfall and runoff, which caused bottles to fill rapidly before crews could get to the sites to change bottles and settings. In all cases the rising limb of the hydrograph and periods of high flow were well represented by the samples.

**Figure 5.1 Monthly Rainfall Totals for the 2002/2003 Wet Weather Season and Normal Rainfall at Long Beach Daugherty Air Field.**



	Belmont Pump	Bouton Creek	Los Cerritos Creek	Dominguez Gap	Long Beach Airport	Long Beach Airport-Normal
<b>October</b>	0.06	0.05	0.04	0.00	0.00	0.40
<b>November</b>	1.97	1.87	1.58	1.23	0.19	1.12
<b>December</b>	2.11	1.99	2.12	1.54	1.69	1.76
<b>January</b>	0.00	0.01	0.00	0.00	0.00	2.95
<b>February</b>	3.60	3.77	4.17	4.65	4.40	3.01
<b>March</b>	3.11	3.13	3.26	2.59	0.89	2.43
<b>April</b>	0.94	0.98	0.94	1.12	1.45	0.60
<b>Season Totals</b>	<b>11.79</b>	<b>11.80</b>	<b>12.11</b>	<b>11.13</b>	<b>8.62</b>	<b>12.27</b>

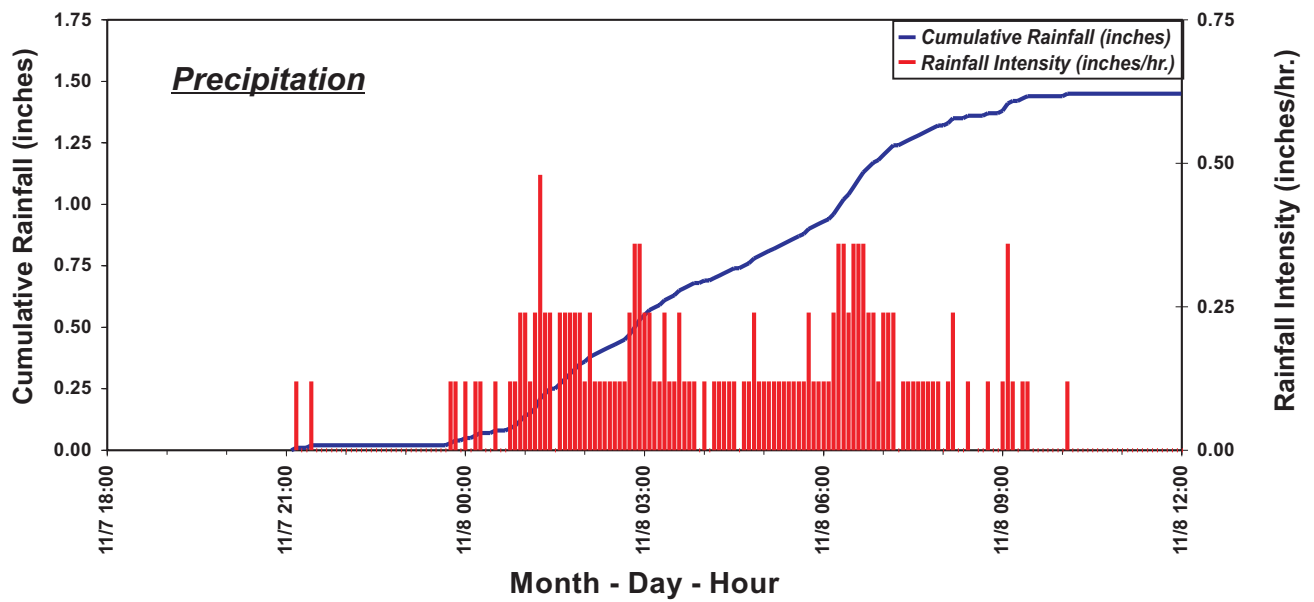
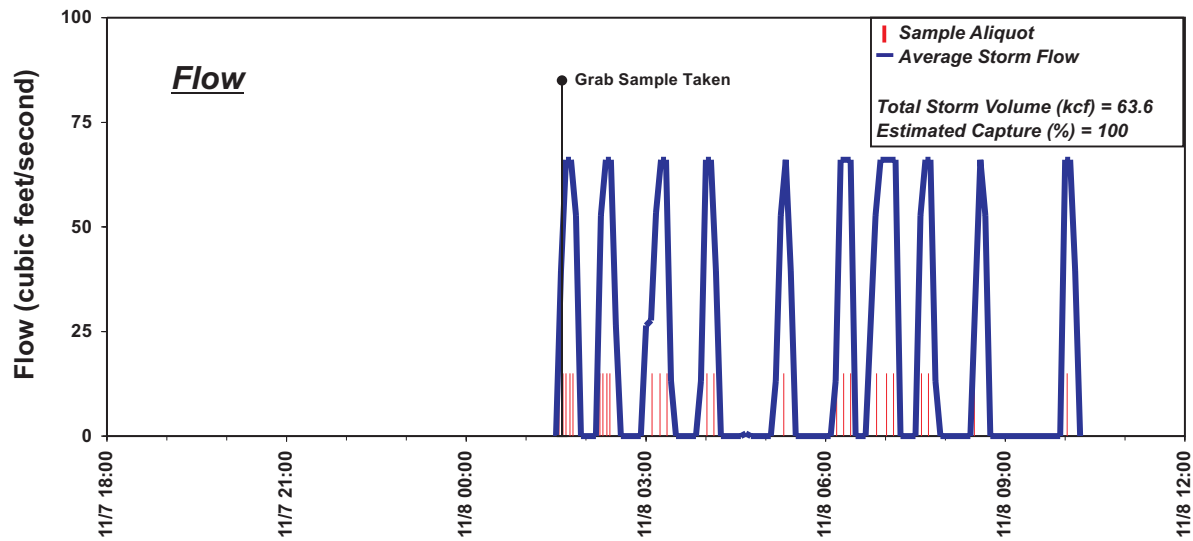


Figure 5.2 - Belmont Pump Station - Event 1 (7 - 8 November, 2002)

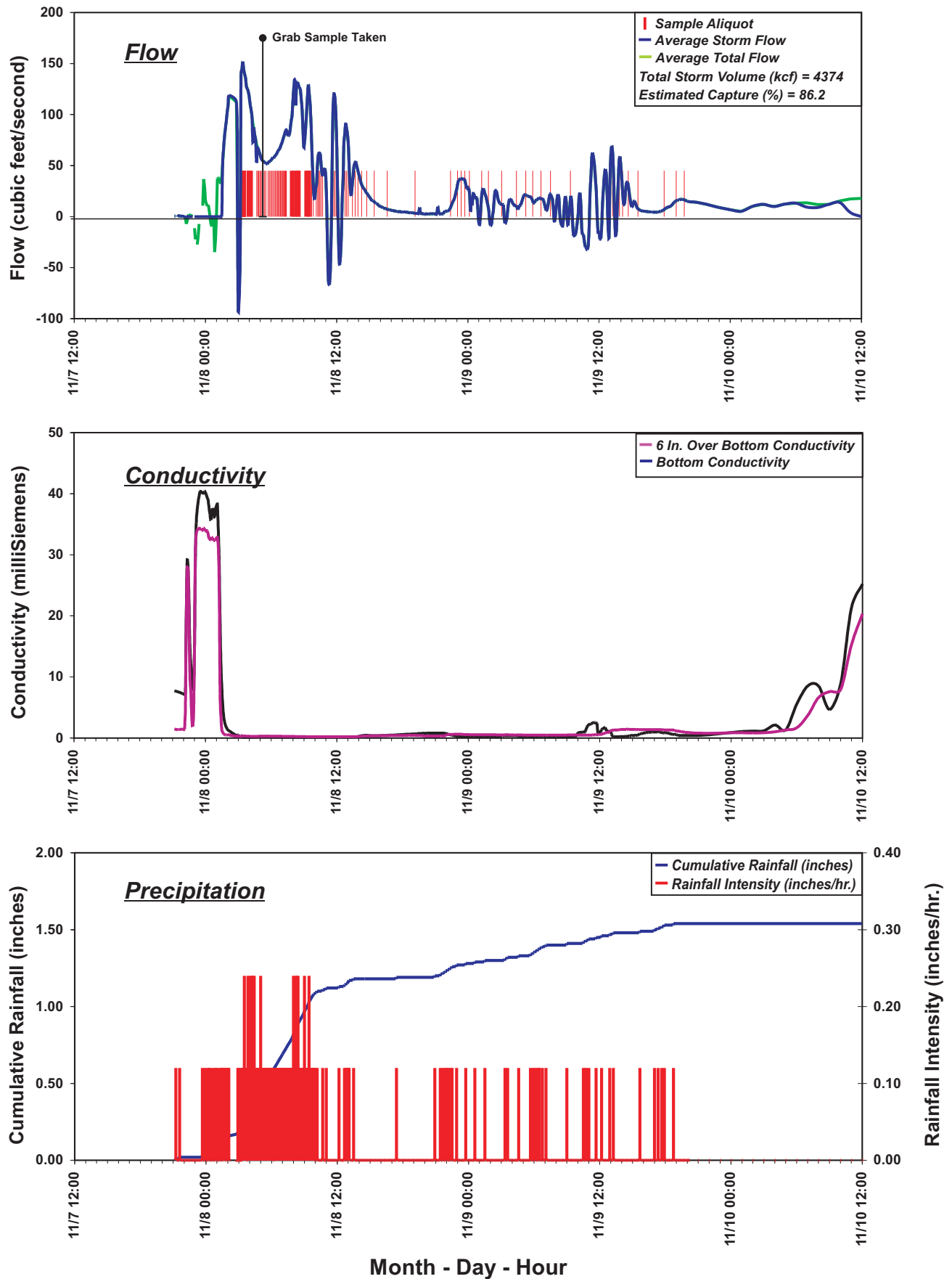


Figure 5.3 - Bouton Creek - Event 1 (7 - 10 November, 2002)

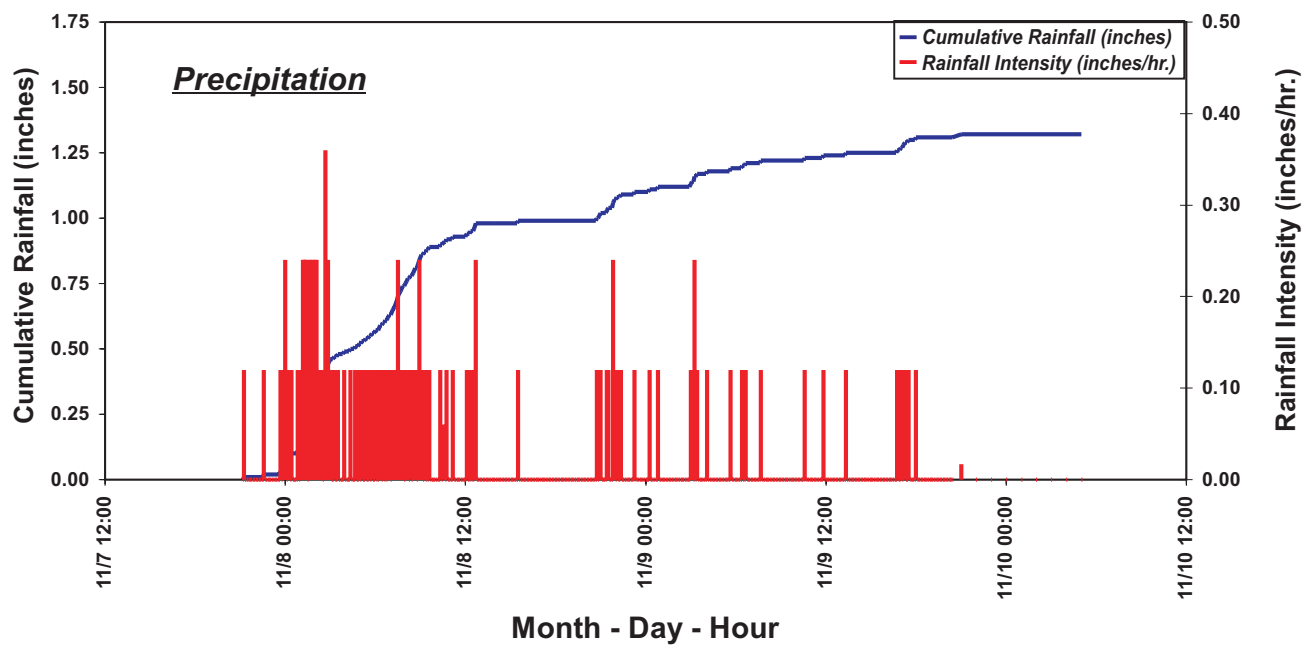
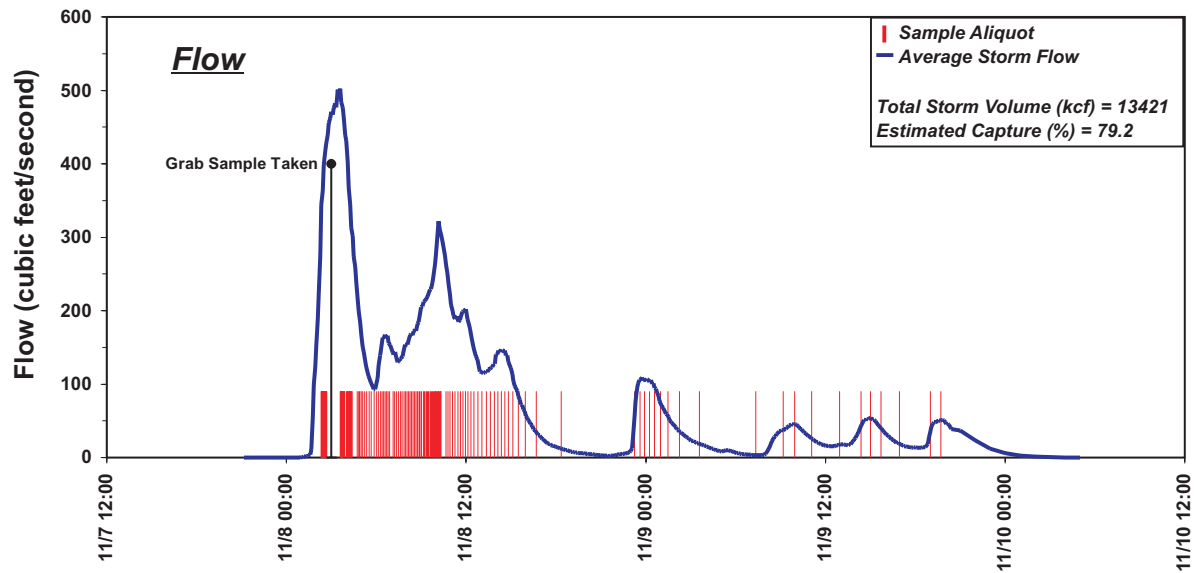


Figure 5.4 - Los Cerritos Channel - Event 1 (8 - 10 November, 2002)

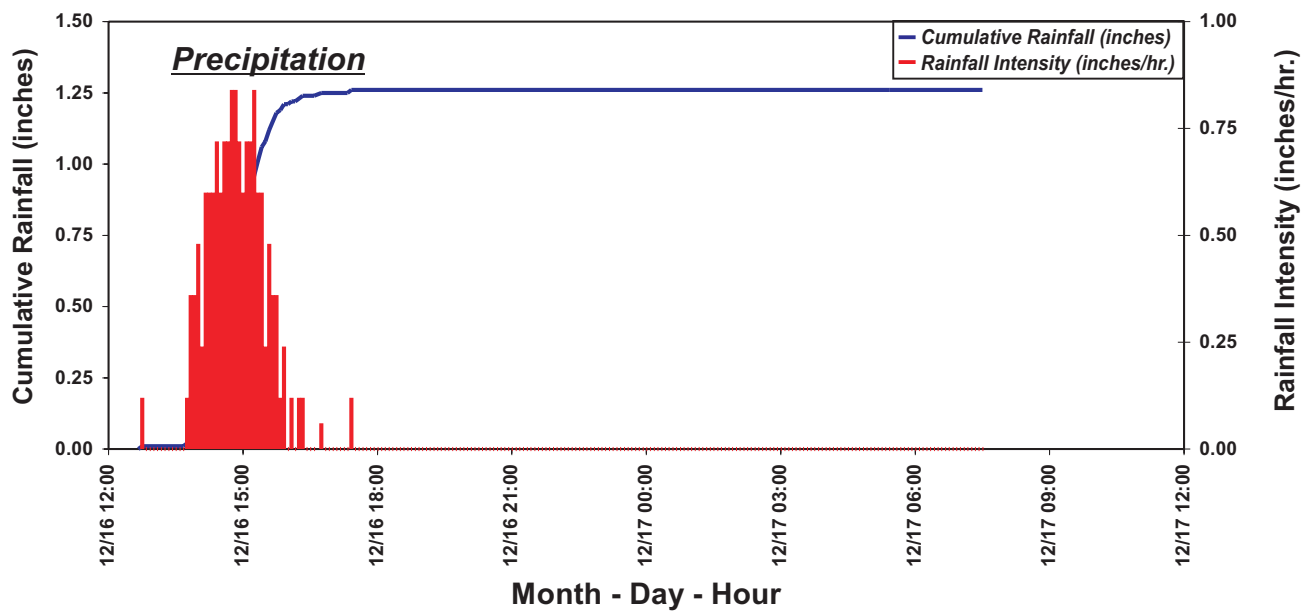
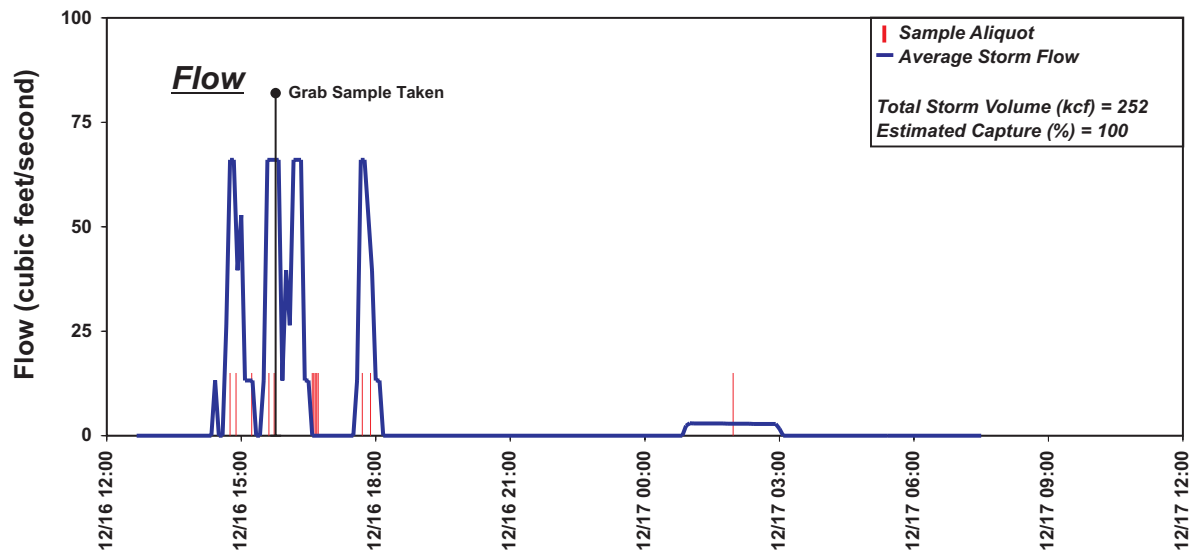


Figure 5.5 - Belmont Pump Station - Event 2 (16 - 17 December, 2002)

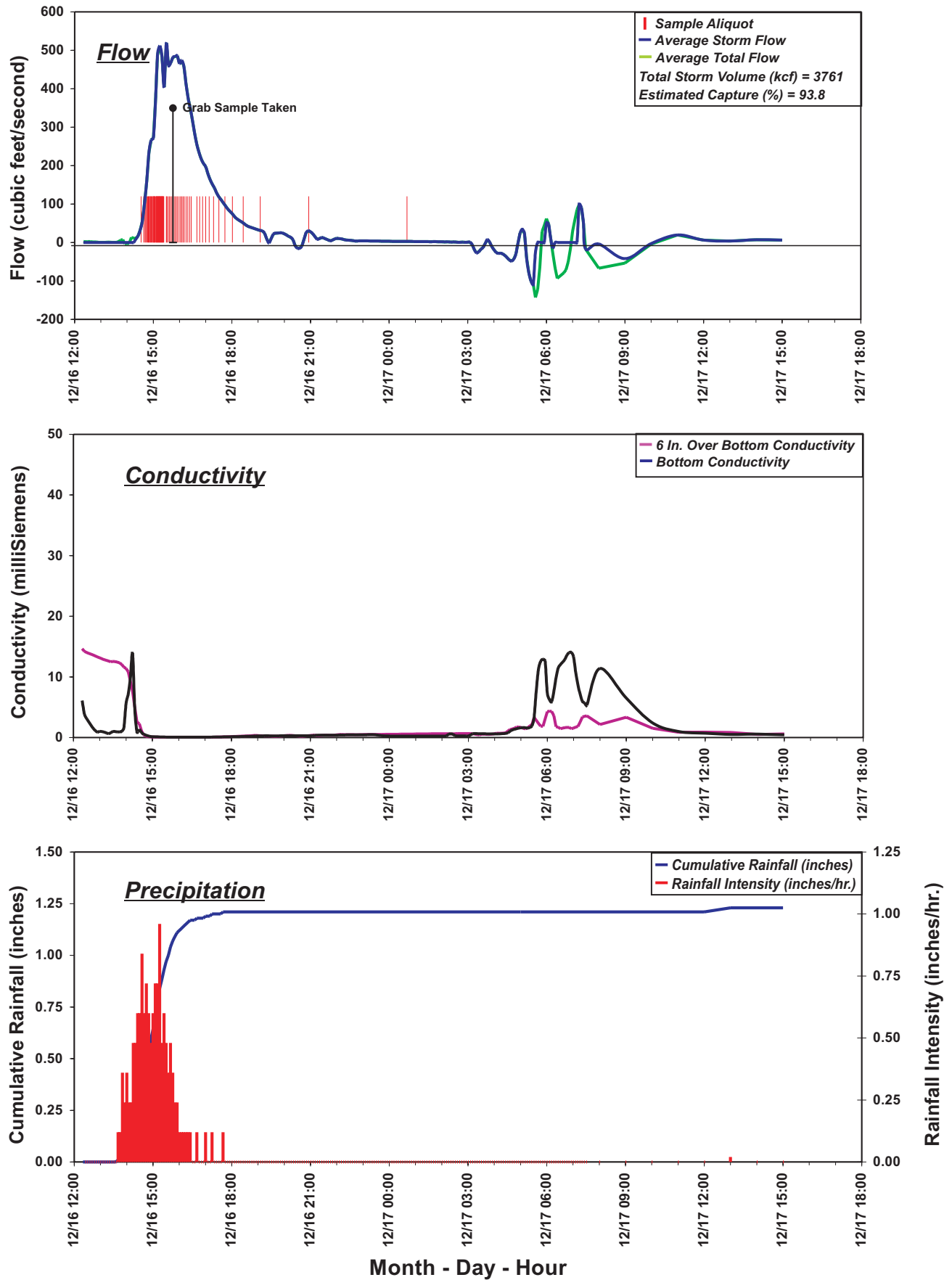


Figure 5.6 - Bouton Creek - Event 2 (16 - 17 December, 2002)

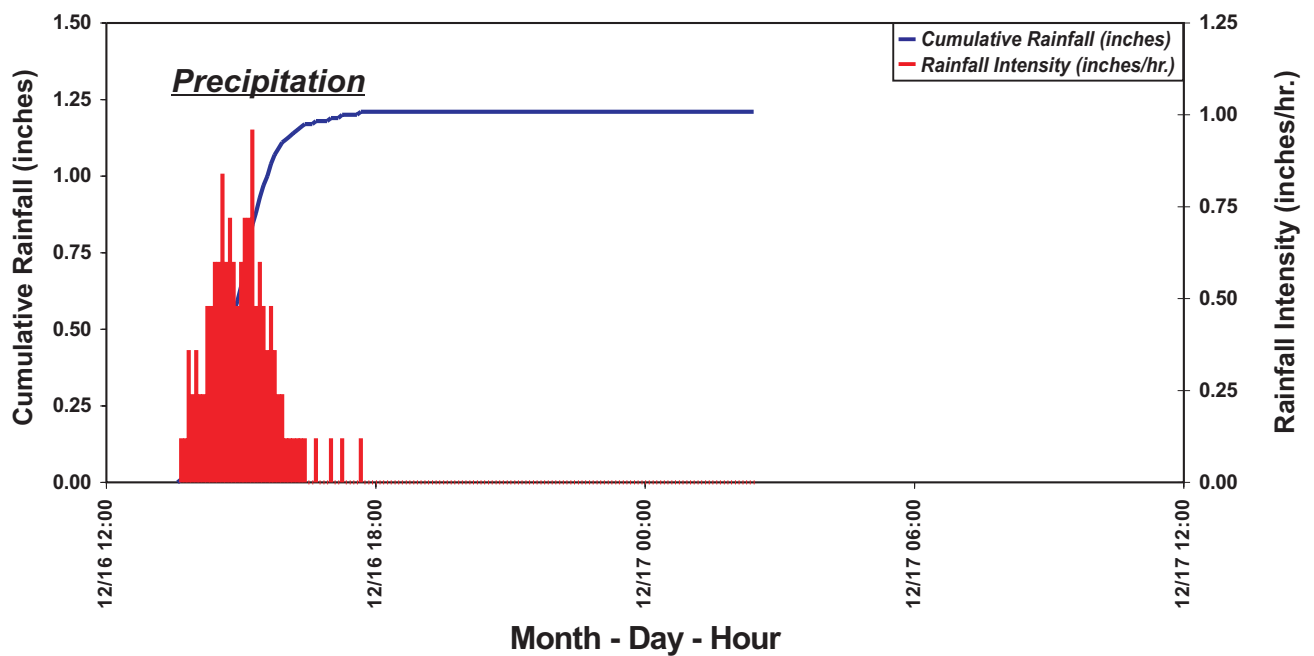
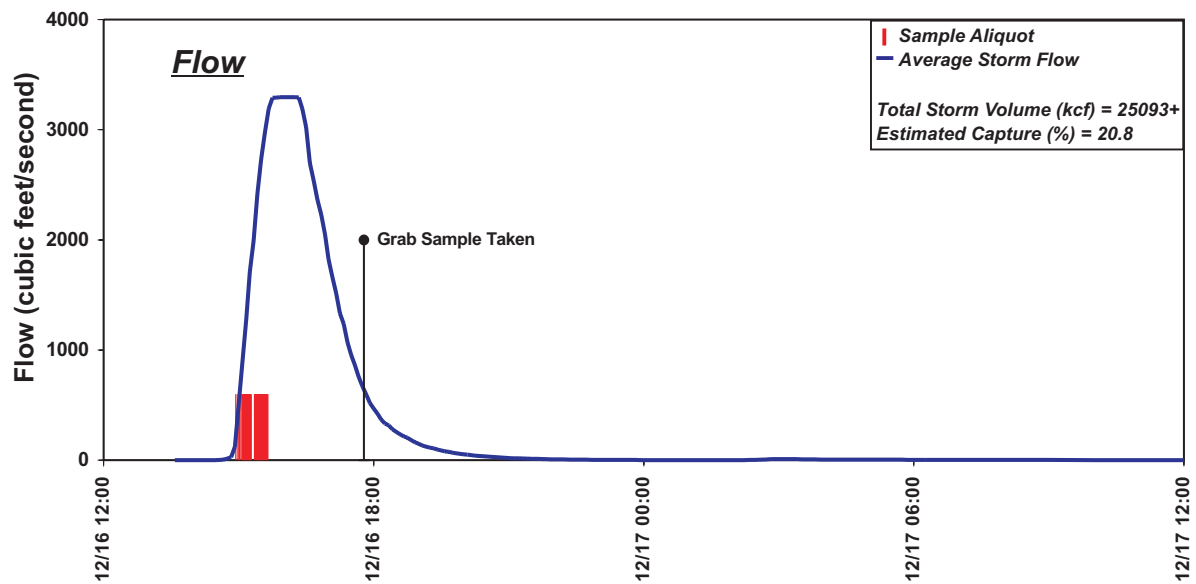


Figure 5.7 - Los Cerritos Channel - Event 2 (16 - 17 December, 2002)

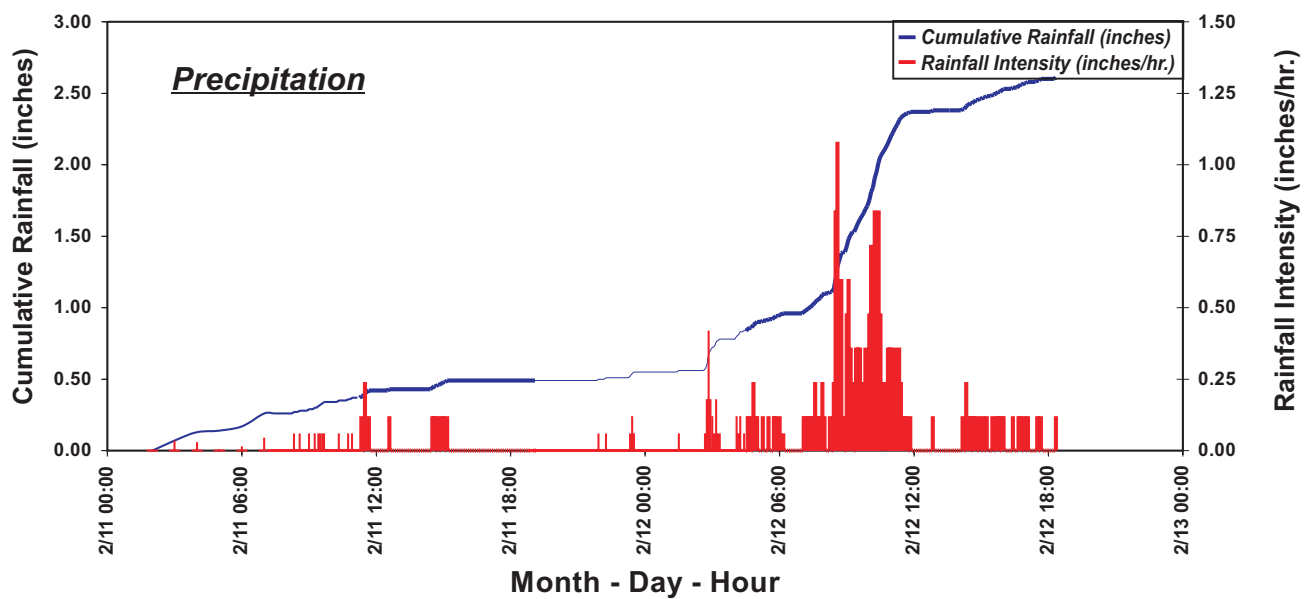
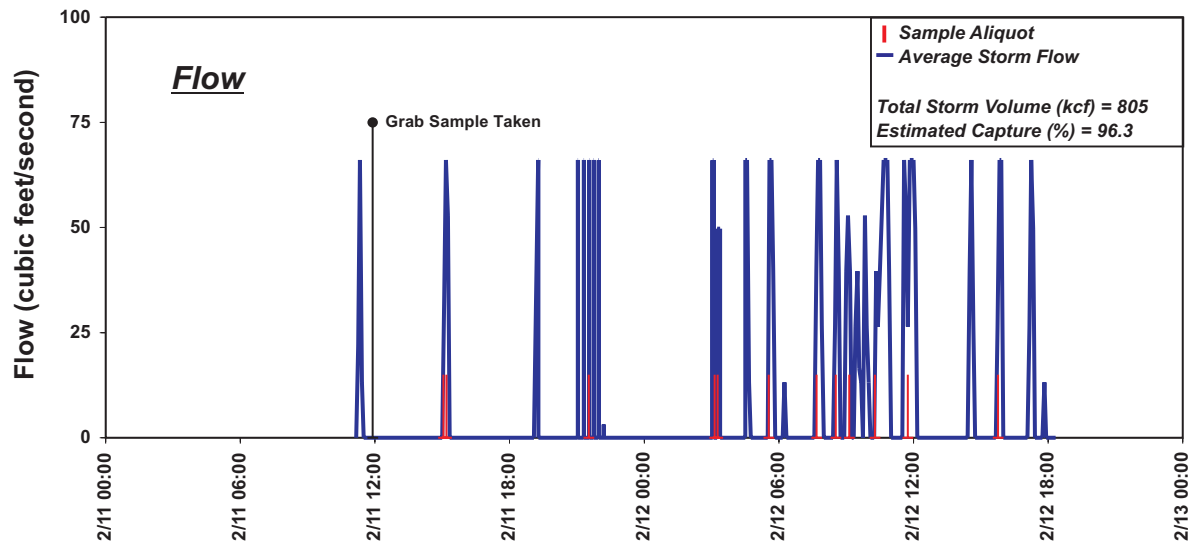


Figure 5.8 - Belmont Pump Station - Event 3 (11 - 12 February, 2003)

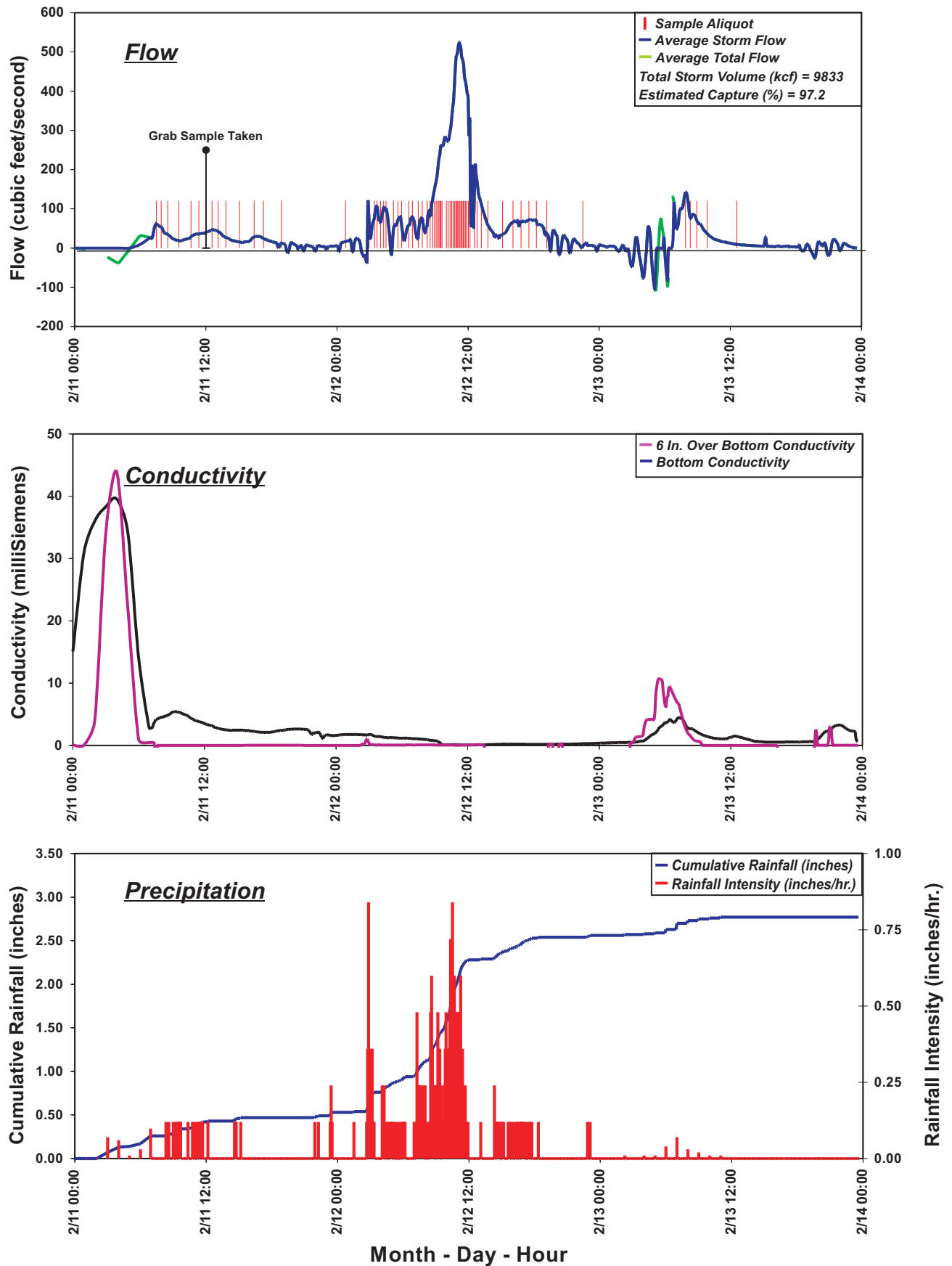


Figure 5.9 - Bouton Creek - Event 3 (11 - 13 February, 2003)

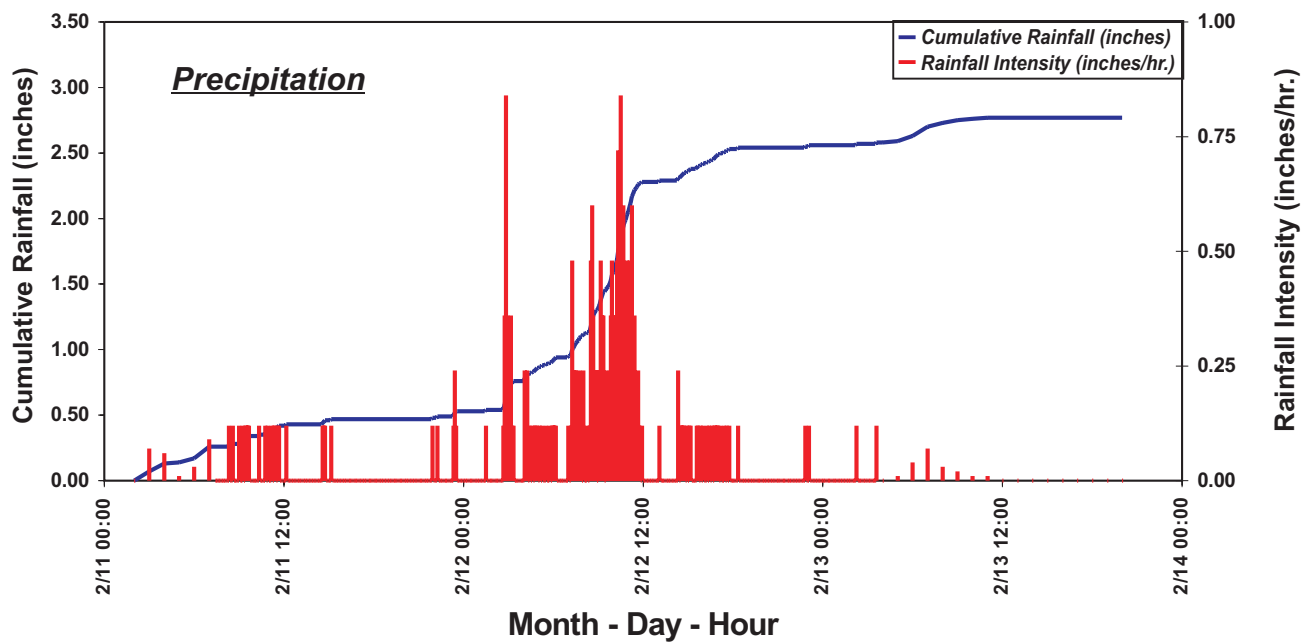
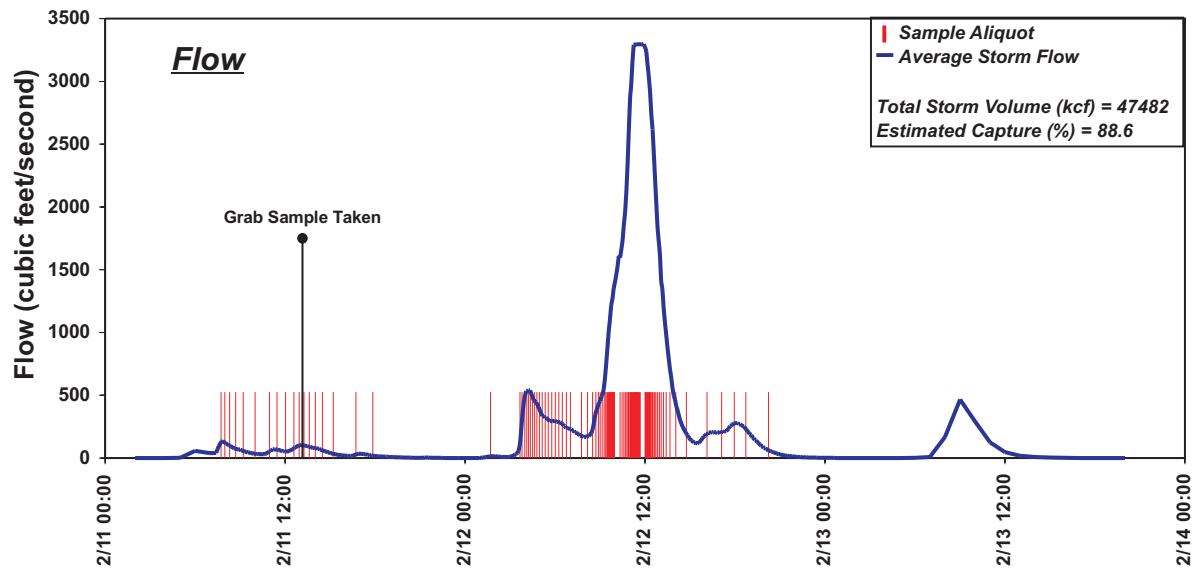


Figure 5.10 - Los Cerritos Channel - Event 3 (11 - 13 February, 2003)

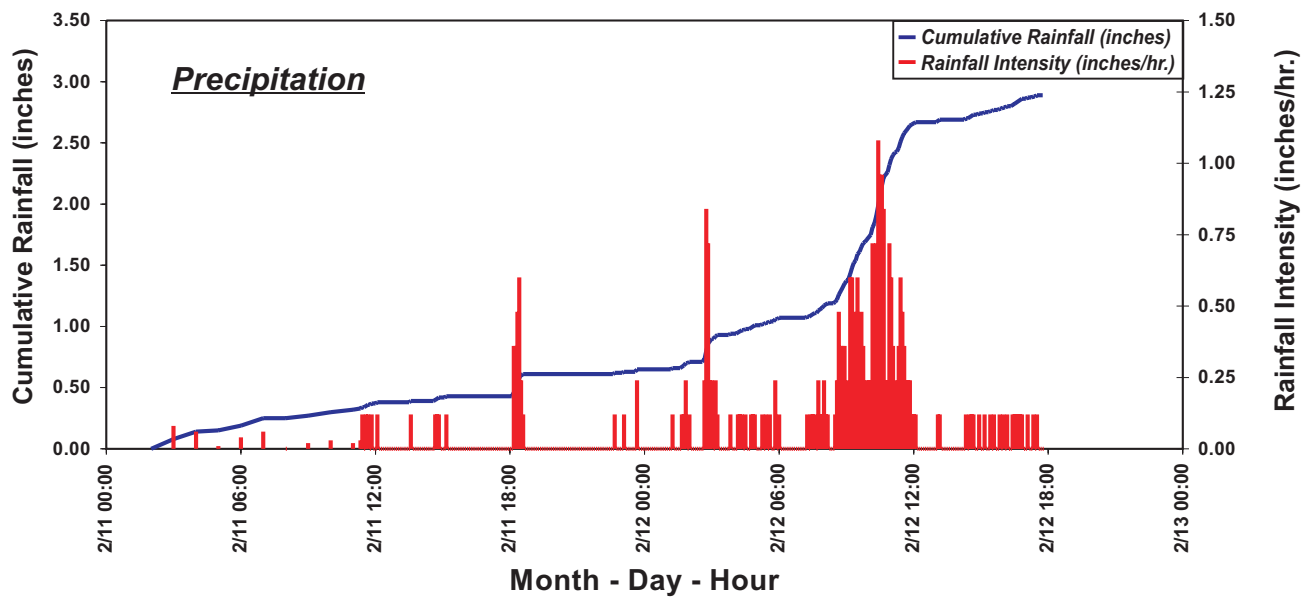
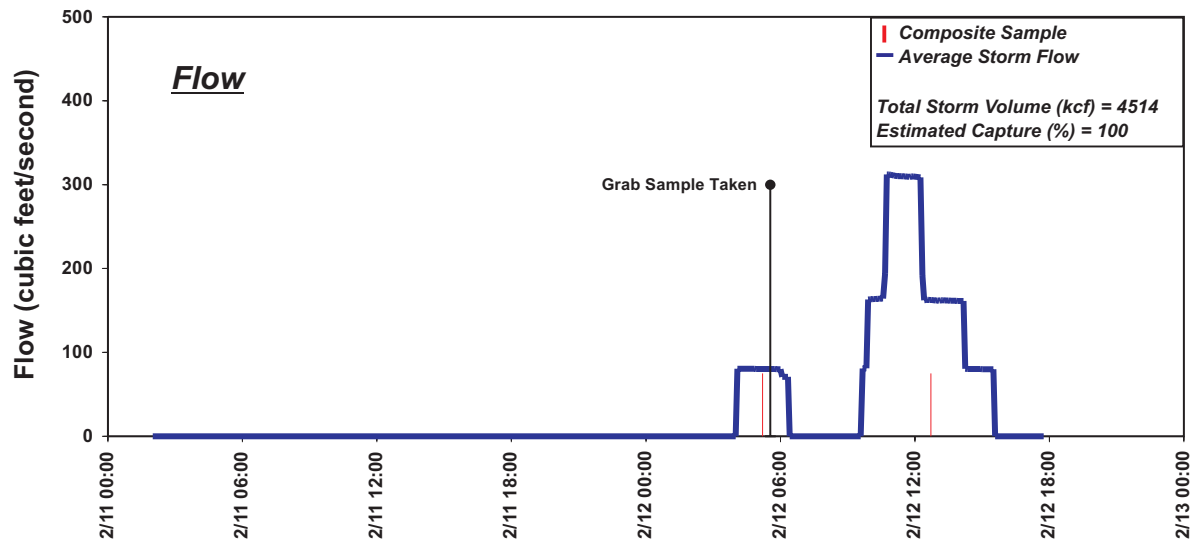


Figure 5.11 - Dominguez Gap Pump Station - Event 3 (11 - 12 February, 2003)

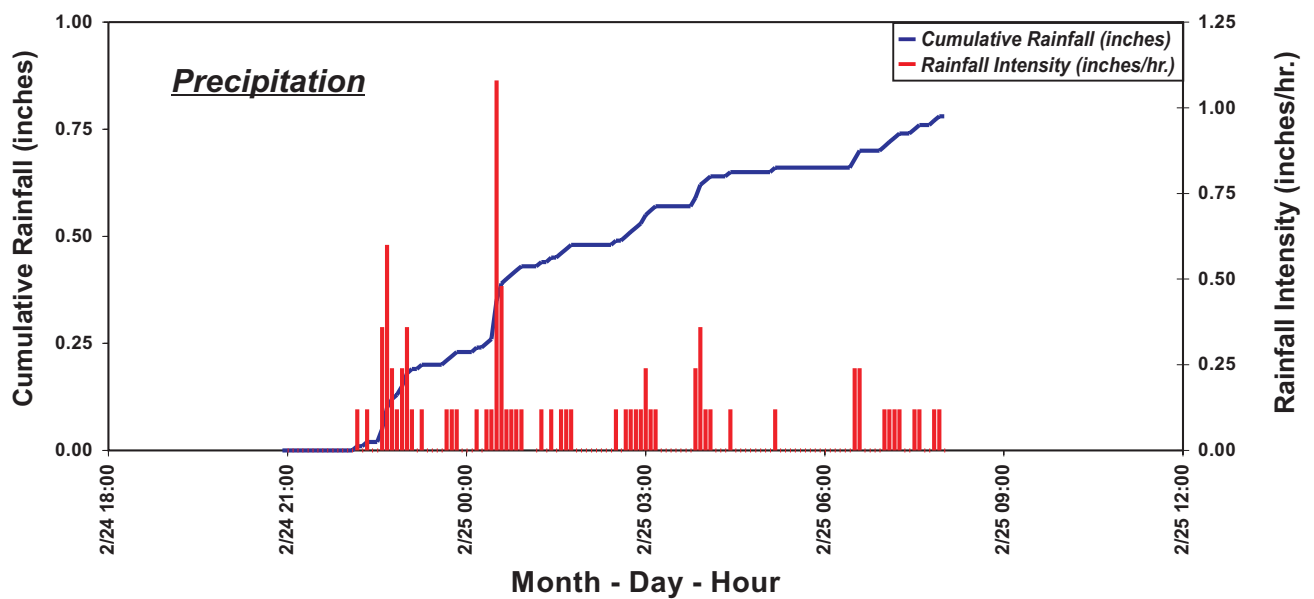
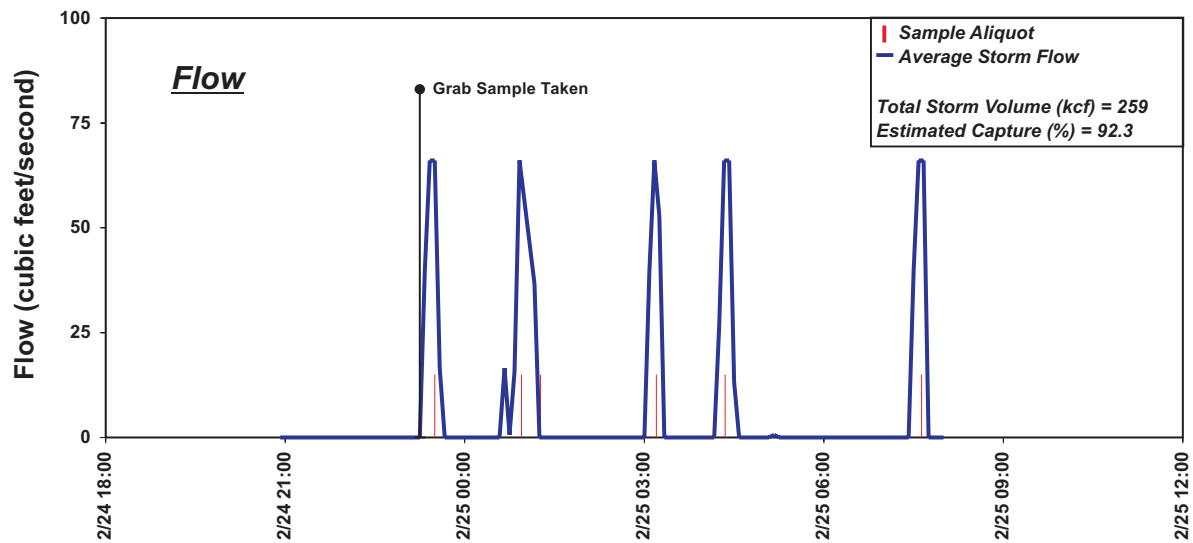


Figure 5.12 - Belmont Pump Station - Event 4 (24 - 25 February, 2003)

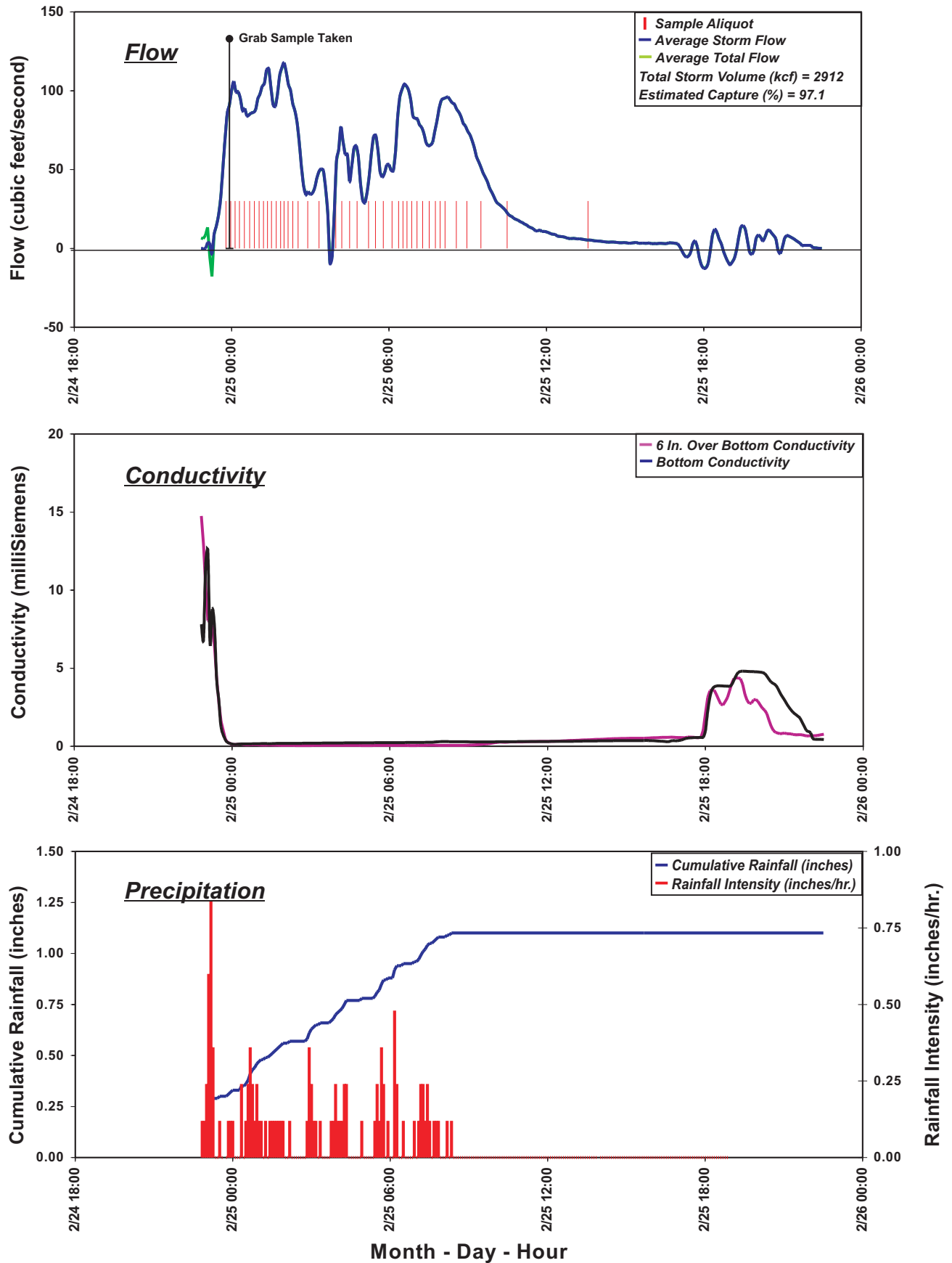


Figure 5.13 - Bouton Creek - Event 4 (24 - 25 February, 2003)

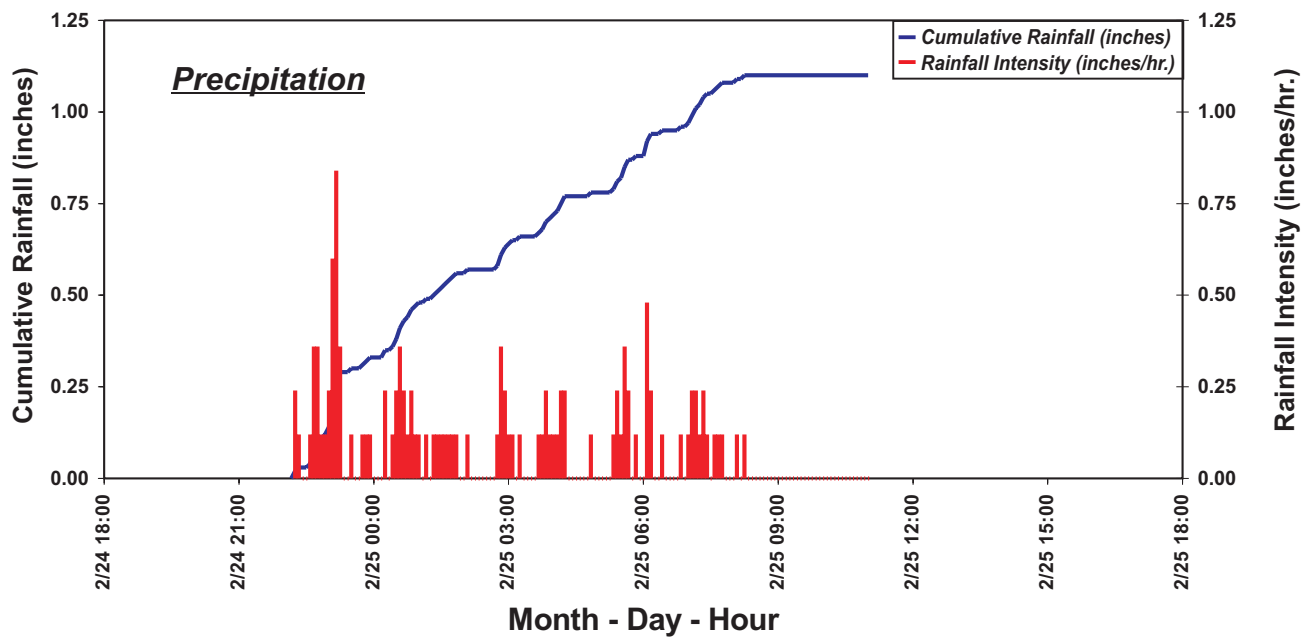
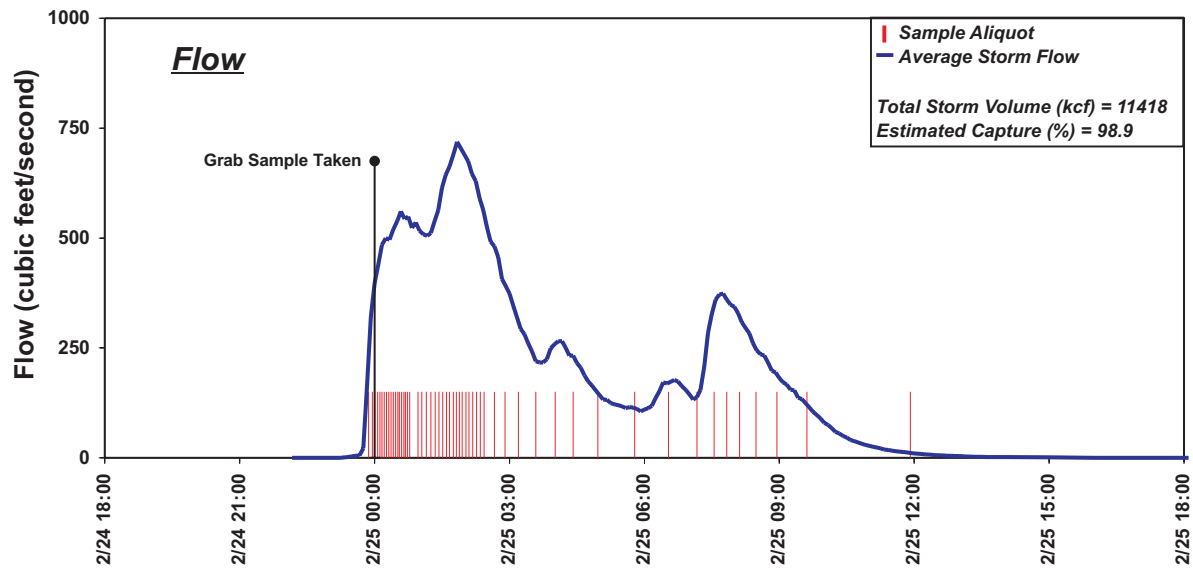


Figure 5.14 - Los Cerritos Channel - Event 4 (24 - 25 February, 2003)

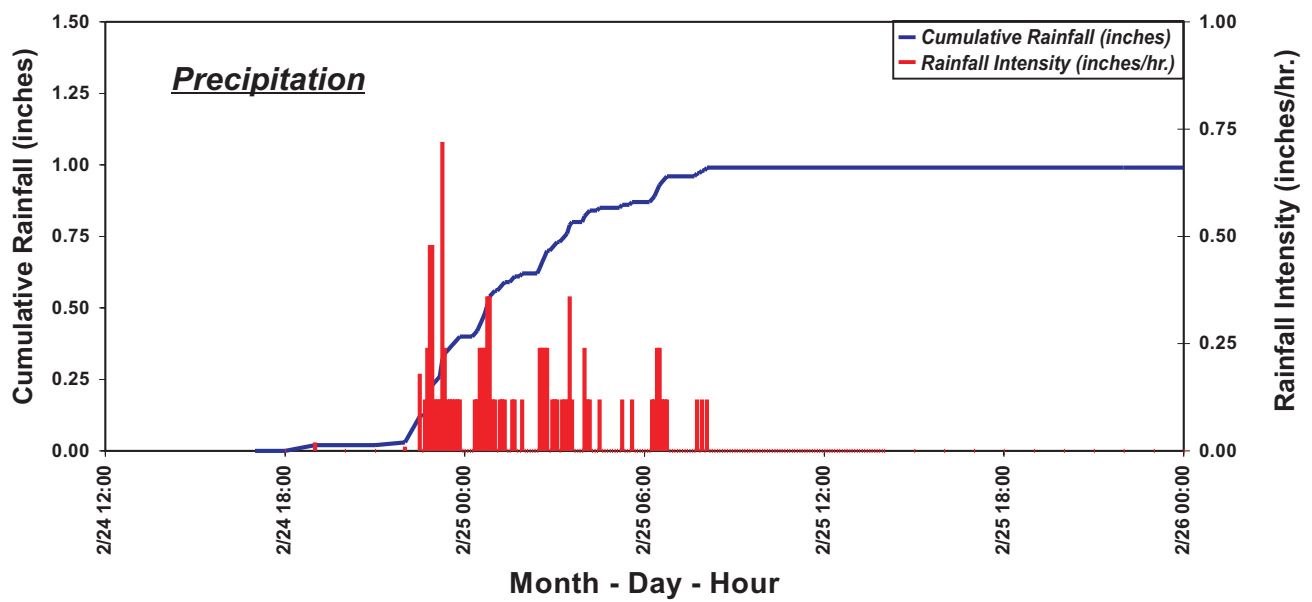
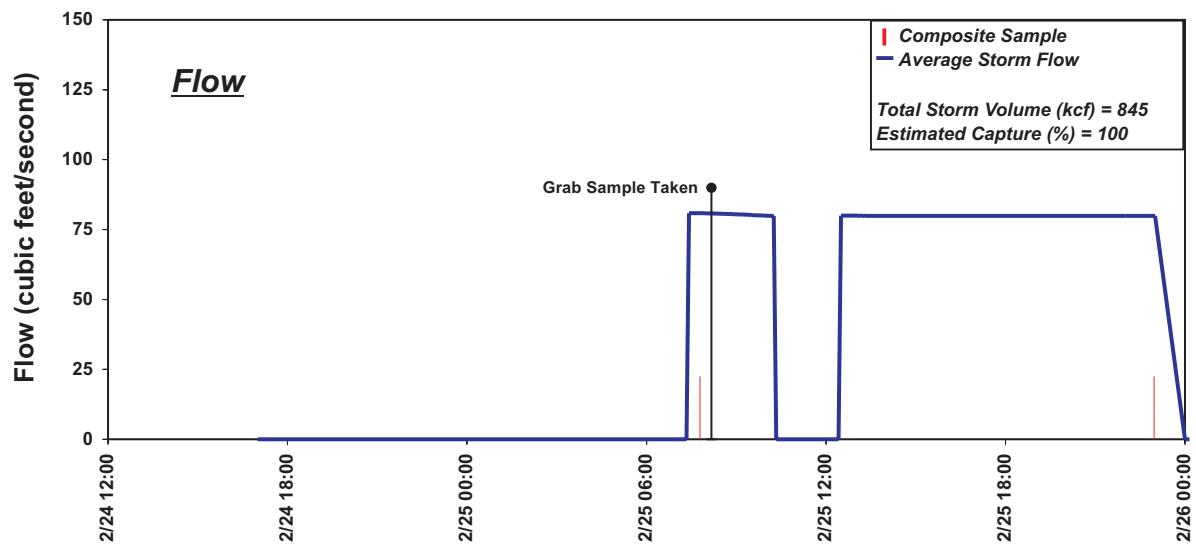


Figure 5.15 - Dominguez Gap Pump Station - Event 4 (24 - 25 February, 2003)

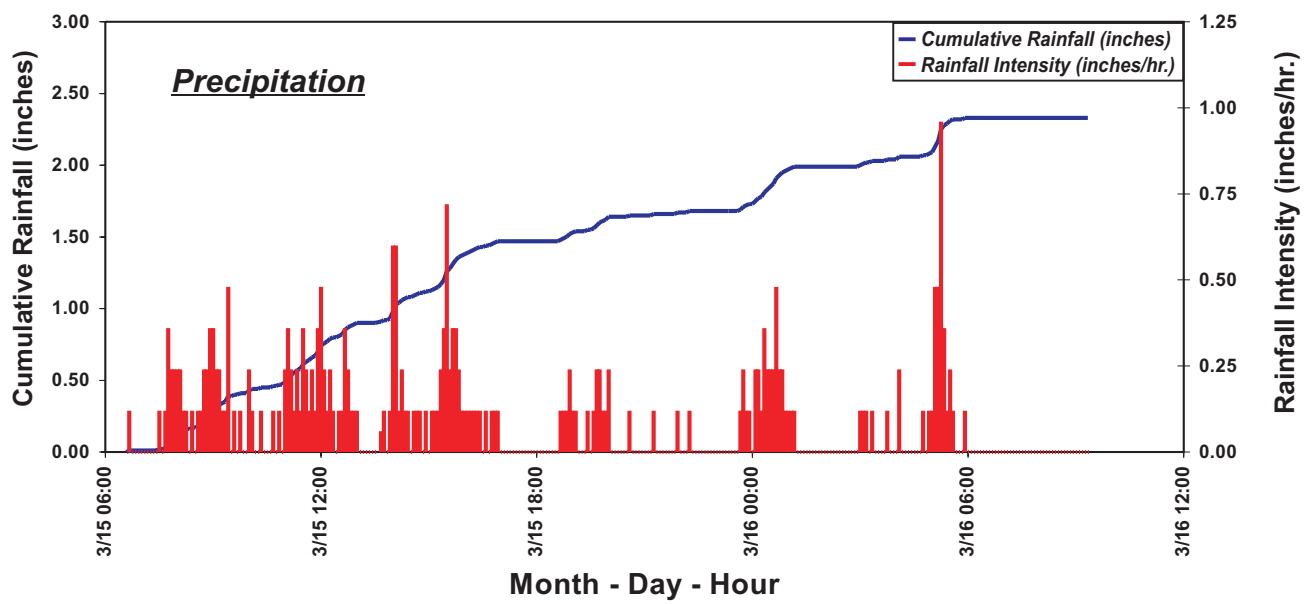
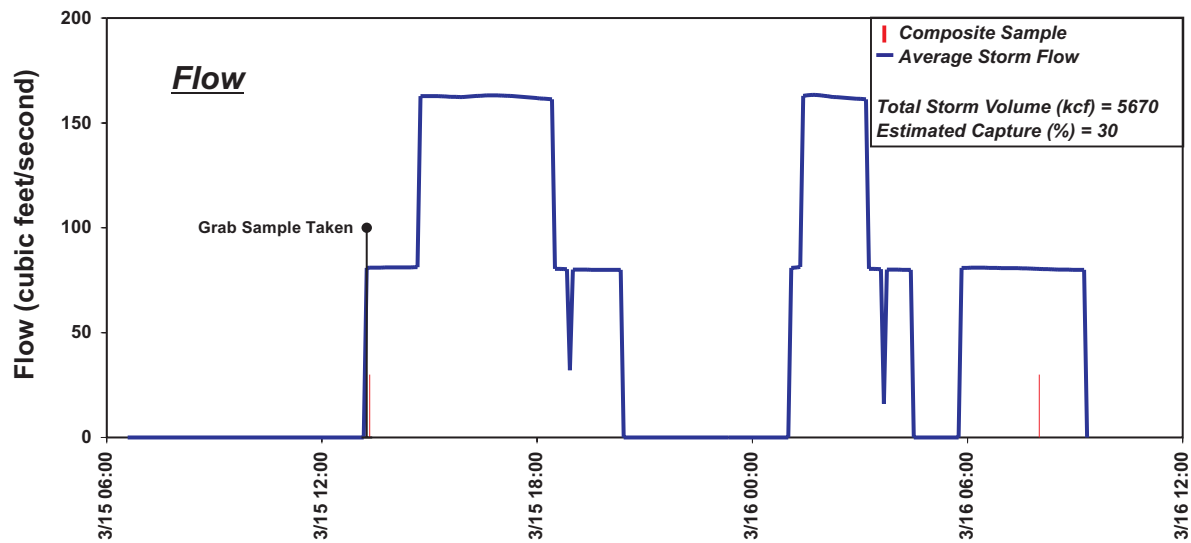


Figure 5.16 - Dominguez Gap Pump Station - Event 5 (15 - 16 March, 2003)

**Table 5.1 Rainfall for Monitored Events during the 2002/2003 Wet-Weather Season.**

Site/Event	Start Rain		End Rain		Duration Rain (hrs:mins)	Total Rain (inches)	Max Intensity (Inches/hr)	Antecedent Rain (days)	Antecedent Rain (inches)
	Date	Time	Date	Time					
EVENT 1									
Belmont Pump Station	11/7/02	21:07	11/8/02	10:05	12:58:00	1.45	0.48	>120	-
Bouton Creek	11/7/02	21:15	11/9/02	18:45	45:30:00	1.54	0.24	>120	-
Los Cerritos Creek	11/7/02	21:15	11/9/02	21:00	47:45:00	1.32	0.36	>120	-
EVENT 2									
Belmont Pump Station	12/16/02	12:45	12/16/02	17:25	4:40:00	1.26	0.84	16.4	0.23
Bouton Creek	12/16/02	13:40	12/16/02	17:40	4:00:00	1.21	0.96	16.1	0.32
Los Cerritos Creek	12/16/02	13:50	12/16/02	17:40	3:50:00	1.21	0.96	16.2	0.16
EVENT 3									
Belmont Pump Station	2/11/03	11:15	2/12/03	18:20	31:05:00	2.19	1.08	51.3	0.60
Bouton Creek	2/11/03	3:00	2/13/03	11:00	56:00:00	2.77	0.84	51	0.69
Los Cerritos Creek	2/11/03	3:00	2/13/03	2:15	47:15:00	2.57	0.84	51	0.16
Dominguez Gap Pump Station	2/11/03	3:00	2/13/03	10:00	55:00:00	3.26	1.08	51.1	0.43
EVENT 4									
Belmont Pump Station	2/24/03	22:10	2/25/03	10:35	12:25:00	0.8	1.08	0.4	0.12
Bouton Creek	2/24/03	22:15	2/25/03	8:15	10:00:00	1.1	0.84	11.5	2.57
Los Cerritos Creek	2/24/03	22:15	2/25/03	8:15	10:00:00	1.1	0.84	11.5	2.57
Dominguez Gap Pump Station	2/24/03	22:00	2/25/03	8:05	10:05:00	0.97	0.72	11.5	3.26
EVENT 5									
Dominguez Gap Pump Station	3/15/03	6:40	3/16/03	5:55	23:15:00	1.43	0.96	6.9	0.26

**Table 5.2 Flow for Monitored Events during the 2002/2003 Wet-Weather Season.**

Site/Event	Start Flow		End Flow		Duration Flow (hrs:mins)	Total Flow (kilo-cubic feet)	No. of Sample Aliquots Collected	Peak Flow (cfs)	% Capture	Peak Capture
	Date	Time	Date	Time						
EVENT 1										
Belmont Pump Station	11/8/02	1:33	11/8/02	10:02	8:29:00	63.6	25	66	100	Y
Bouton Creek	11/8/02	1:35	11/11/02	2:00	72:25:00	4374	133	154	86.2	Y
Los Cerritos Creek	11/7/02	23:55	11/10/02	4:00	52:05:00	13421	154 (141)	502	79.2	Y
EVENT 2										
Belmont Pump Station	12/16/02	14:23	12/17/02	3:00	12:37:00	252	8	66	100	Y
Bouton Creek	12/16/02	14:02	12/17/02	7:25	17:23:00	3761	70	527	93.8	Y
Los Cerritos Creek	12/16/02	13:50	12/17/02	13:00	23:10:00	>25093	38	>3295	20.8	N
EVENT 3										
Belmont Pump Station	2/11/03	11:14	2/12/03	17:50	30:36:00	805	12	66	96.3	Y
Bouton Creek	2/11/03	6:54	2/13/03	23:30	64:36:00	9833	73	523	97.2	Y
Los Cerritos Creek	2/11/03	4:00	2/13/03	19:00	63:00:00	47482	100	>3295	88.6	Y
Dominguez Gap Pump Station	2/12/03	4:05	2/13/03	15:30	35:25:00	4514	2	312	N/A	
EVENT 4										
Belmont Pump Station	2/24/03	22:20	2/25/03	10:05	11:45:00	259	6	66	92.3	Y
Bouton Creek	2/24/03	23:05	2/25/03	22:25	23:20:00	2912	42	118	97.1	Y
Los Cerritos Creek	2/24/03	23:10	2/25/03	18:00	18:50:00	11418	55	719	98.9	Y
Dominguez Gap Pump Station	2/25/03	7:25	2/25/03	10:15	2:50:00	845	2	81	N/A	
EVENT 5										
Dominguez Gap Pump Station	3/15/03	13:15	3/16/03	9:15	20:00:00	5670	10	163	N/A	N

**Table 5.3 Cumulative Descriptive Statistics for Rainfall and Flow Data for All Monitored Events (2002/2003)**

Site / Parameter	n	Min	Max	Mean	Standard Deviation	1st Quartile	Median	3rd Quartile
<b>BELMONT PUMP ST.</b>								
Duration Flow (days)	4	0.35	1.28	0.66	0.42	0.46	0.51	0.71
Total Storm Vol. (kcf)	4	63.6	805	345	320	205	255	395
Duration Rain (days)	4	0.19	1.30	0.64	0.47	0.44	0.53	0.73
Total Rain (in)	4	0.80	2.19	1.43	0.58	1.15	1.36	1.64
Max Intensity (in/hr)	4	0.48	1.08	0.87	0.28	0.75	0.96	1.08
Antecedent Dry (days)	4	0.40	120.00	47.03	53.09	12.40	33.85	68.48
Antecedent Rain (in)	3	0.12	0.60	0.32	0.25	0.18	0.23	0.42
<b>BOUTON CREEK</b>								
Duration Flow (days)	4	0.72	3.02	1.85	1.17	0.91	1.83	2.77
Total Storm Vol. (kcf)	4	2910	9830	5220	3130	3550	4070	5740
Duration Rain (days)	4	0.17	2.33	1.20	1.07	0.35	1.16	2.01
Total Rain (in)	4	1.10	2.77	1.66	0.77	1.18	1.38	1.85
Max Intensity (in/hr)	4	0.24	0.96	0.72	0.32	0.69	0.84	0.87
Antecedent Dry (days)	4	11.50	120.00	49.65	50.11	14.95	33.55	68.25
Antecedent Rain (in)	3	0.32	2.57	1.19	1.21	0.51	0.69	1.63
<b>LOS CERRITOS CHANNEL</b>								
Duration Flow (days)	4	0.78	2.63	1.64	0.90	0.92	1.57	2.28
Total Storm Vol. (kcf)	4	11400	47500	24400	16600	12900	19300	30700
Duration Rain (days)	4	0.16	1.99	1.13	0.98	0.35	1.19	1.97
Total Rain (in)	4	1.10	2.57	1.55	0.69	1.18	1.27	1.63
Max Intensity (in/hr)	4	0.36	0.96	0.75	0.27	0.72	0.84	0.87
Antecedent Dry (days)	4	11.50	120.00	49.68	50.08	15.03	33.60	68.25
Antecedent Rain (in)	3	0.16	2.57	0.96	1.39	0.16	0.16	1.37
<b>DOMINGUEZ GAP PUMP ST.</b>								
Duration Flow (days)	3	0.12	1.48	0.81	0.68	0.48	0.83	1.15
Total Storm Vol. (kcf)	3	845	5670	3680	2520	2680	4510	5090
Duration Rain (days)	3	0.42	2.29	1.23	0.96	0.69	0.97	1.63
Total Rain (in)	3	0.97	3.26	1.89	1.21	1.20	1.43	2.35
Max Intensity (in/hr)	3	0.72	1.08	0.92	0.18	0.84	0.96	1.02
Antecedent Dry (days)	3	6.90	51.10	23.17	24.30	9.20	11.50	31.30
Antecedent Rain (in)	3	0.26	3.26	1.32	1.69	0.35	0.43	1.85

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## **6.0 CHEMISTRY RESULTS**

### **6.1 Wet Weather Chemistry Results**

Despite the fact that total seasonal rainfall was still below normal, more events were monitored during the 2002/2003 season than any previous monitoring year. Four storm events were monitored at the Bouton Creek, Belmont Pump and Los Cerritos Channel sites and three events were monitored from the Dominguez Gap Pump Station site. The three events monitored at the Dominguez Gap Pump Station were all late season events from February and March. These were the only stormwater discharges that occurred at this location during the monitoring year (Table 6.1).

For each of these monitored events, all chemical constituents except for the semivolatile organic compounds summarized in Table 4.2 were analyzed in the resulting samples for each station. Analysis of semivolatile organic compounds were suspended for the current monitoring year in order to investigate alternatives for lower detection limits for the polycyclic aromatic hydrocarbons. Composite samples collected during these storm events were also tested for toxicity with two species, the water flea (freshwater crustacean) and sea urchin (marine).

The results of the chemical analysis of these composite and grab stormwater samples are summarized in Table 6.2 and 6.3. Toxicity results for the composite samples and the receiving water samples from these monitored events are given in Section 7 below.

### **6.2 Wet Weather Load Calculations**

Estimates of total pollutant loads associated with stormwater runoff during each storm event are provided in Tables 6.4 through 6.7. Load calculations were made by multiplying the measured concentration times the total stormwater discharge along with the appropriate unit conversion factors. The following calculation is an example of the process used for analytes such as TSS that are measured in mg/L. The specific example is for the third storm event at Bouton Creek

$$(72 \text{ mg/L}) \times [(9833 \text{ kcf})(28317 \text{ L/kcf})] \times (1 \text{ pound}/453592 \text{ mg}) = 44,197 \text{ pounds}$$

Among the four mass emission sites, the Los Cerritos Channel consistently results in the highest overall loads of solids and total metals. Estimates of solids discharged at the Los Cerritos Channel site ranged from 92,163 to 704,927 pounds. Estimates of total copper ranged from 14 to 143 pounds. In contrast, the Belmont Pump Station was estimated to discharge between 397 and 4018 pounds of solids and 0.22 to 1.7 pounds of copper during each event.

Loading estimates for solids and total recoverable metals from the Dominguez Gap Pump Station were 20 to 40 times lower than those from the Los Cerritos Channel during the two storms when both sites were monitored. The drainage area for the Dominguez Gap Pump station is approximately three times greater than the drainage area for the Los Cerritos Channel site.

### **6.3 Dry Weather Sampling Results**

The NPDES Permit calls for two dry weather inspections and sampling events to be carried out during the summer dry weather period at each of the four mass emission stations. During the 1999/2000 year, the two dry weather inspections/sampling events were done in late June so that the results could be reported in the annual report due 15 July 2000. For the second year, the first of these dry weather inspections/samplings was done at all sites in June 2001 and the results are reported in the 2001 annual report. The second sampling event was conducted later in the summer, and the results from this second event were reported as an addendum to the 2002 annual report. The 2002 report also included a sampling event in May 2002.

In the 2002/2003 year, dry weather inspection/sampling events were again performed before the beginning of the storm season, in September 2002, and at the end of the storm season, in May 2003. All dry weather events monitored during the previous monitoring seasons are summarized in Table 6.8 below. Events 7 and 8 conducted during the 2002/2003 season are shaded. Field measurements are provided in Table 6.9. Chemical analyses performed in the laboratory are summarized in Table 6.10.

#### **6.3.1 Basin 14: Dominguez Gap Monitoring Site**

Inspections for dry weather flow were conducted at the Dominguez Gap Pump Station on 04 September 2002 and on 19 May 2003. No dry weather flow was observed on either occasion. The basin in front of the pump house had standing water in it but field crews were unable to reach the water to measure the depth. The source of this ponded water was not determined due to the lack of flow. The concrete lined channel that extends east from, and discharges into, the basin had small, isolated pools of standing water, but there was no flow. There was also no flow observed from the north part of the basin. It is apparent that water from the Los Angeles River was not being diverted into the swale for ground water recharge as observed in 2001.

#### **6.3.2 Basin 20: Bouton Creek Monitoring Site**

On 5 September 2002, Bouton Creek was sampled from 4:00 a.m. to 5:00 a.m. This time corresponded to a period of low tide when the flow in the creek was not impeded by seawater backing into the creek. The tide levels at this time were between negative 0.43 and negative 0.3 feet in the Long Beach area. This assured that the flow was fresh water flowing downstream in the creek and that that saline tidal water did not commingle with the dry weather discharge of fresh water.

Every 10 minutes during the 1-hour period, a 2.86-liter aliquot of water was pumped from the creek using the automatic sampler installed at the site. An aliquot was deposited into each of four 20-liter borosilicate glass bottles. At the conclusion of the sampling, grab samples for MTBE, TPH and bacteria were collected.

Bouton Creek was also sampled on 20 May 2003 from 9:00 a.m. to 9:30 a.m. Samples were collected from the creek and deposited into four 20-liter borosilicate glass bottles using the automatic sampler. For this event, the sampler was moved from the station to the creek bed because the water level was very low. Also, samples were continuously collected rather than collected in 10-minute intervals as previously done to ensure that the freshwater flow was captured. The tide levels at this time were between negative 0.45 and negative 0.46 feet in the Long Beach area. At the conclusion of the sampling at 9:50 a.m., grab samples for MTBE, TPH and bacteria were collected.

### **6.3.3 Basin 23: Belmont Pump Station Monitoring Site**

Time-weighted composite sampling was conducted over a 24-hour period starting on 4 September 2002 and ending on 5 September 2002. Samples were collected from the sump using the automated sampler installed outside of the pump house. Samples were collected into three 20-liter borosilicate bottles. Every half-hour for the 24 hours, an aliquot of approximately 1.25 liters of water was pumped from the sump into a 20-liter bottle. The bottles were changed every eight hours and chilled to 4°C with ice during sampling and transportation. Following completion of the sampling, the three bottles of water were combined into a composite. Upon completion of the 24-hour sampling, on 5 September 2002 at 7:30 a.m., grab samples for MTBE, TPH and bacteria were manually collected from the sump.

Time-weighted composite sampling was again conducted over a 24-hour period starting on 19 May 2003 and ending on 20 May 2003. Samples were collected into a total of three 20-liter borosilicate bottles and chilled to 4°C with ice during sampling and transportation. An aliquot of approximately 1.25 liters was pumped every half hour into a 20-liter bottle, which was changed after 8 hours. Upon completion of the sampling, the three bottles of water were combined into a composite. At the end of the 24-hour period, on 20 May 2003 at 10:43 a.m., grab samples for MTBE, TPH and bacteria were manually collected from the sump.

### **6.3.4 Basin 27: Los Cerritos Channel Monitoring Site**

Time-weighted sampling was conducted over a 24-hour period of the water flowing through the channel. Sampling began on 4 September 2002 and ended on 5 September 2002. A separate sampling event began on 19 May 2003 and ended on 20 May 2003.

Samples were taken from the middle of the channel using the automated sampler installed on the bank of the channel. In September 2002, the dry weather flow was a narrow stream approximately 10 feet wide and 1.5 inches deep located in the middle of the channel. To reach the water, the sampling hose that is used for sampling stormwater was extended an additional 33 feet. Every half-hour for 24 hours, an aliquot of approximately 1.25 liters of water was pumped into a 20-liter bottle. The bottles were changed every eight hours and chilled to 4°C with ice during sampling and transportation. Following completion of the sampling, the three bottles of water were combined into a composite sample. After the 24-hour sampling, on 5 September 2002 at 6:30 a.m., grab samples were manually collected for MTBE, TPH and bacteria.

In May 2003, the dry weather flow was a narrow stream approximately 42 feet wide and 0.25 inches deep located in the middle of the channel. To reach the stream, the sampling hose was extended an additional 40 feet. Samples were collected into three 20-liter borosilicate bottles. As in the previous sampling event, an aliquot of approximately 1.25 liters of water was pumped into a 20-liter bottle every half-hour for 24 hours. The bottles were changed every eight hours and chilled to 4°C with ice during sampling and transportation. Following completion of the sampling, the three bottles of water were combined into a composite sample. After completion of the 24-hour sampling, on May 20 at 10:00 a.m., grab samples were manually collected for MTBE, TPH and bacteria.

**Table 6.1      Monitored Storm Events, 2002-2003**

<b>Station</b>	<b>Event 1 11/11/02</b>	<b>Event 2 12/12/02</b>	<b>Event 3 2/12/03</b>	<b>Event 4 2/26/03</b>	<b>Event 5 3/16/03</b>
Bouton Creek	<b>X</b>	<b>X</b>	<b>X</b>	<b>X</b>	
Belmont Pump	<b>X</b>	<b>X</b>	<b>X</b>	<b>X</b>	
Los Cerritos Channel	<b>X</b>	<b>X</b>	<b>X</b>	<b>X</b>	
Dominguez Gap			<b>X</b>	<b>X</b>	<b>X</b>

**Table 6.2 Stormwater Chemistry Results: City of Long Beach Storm Monitoring Project, Bouton Creek and Belmont Pump Station  
(Page 1 of 4)**

	Bouton Creek 1	Bouton Creek 2	Bouton Creek 2FD	Bouton Creek 3	Bouton Creek 4	Belmont Pump 1	Belmont Pump 2	Belmont Pump 2FD	Belmont Pump 3	Belmont Pump 4
ANALYTE	11 Nov '02	12 Dec '02	12 Dec '02	12 Feb '03	25 Feb '03	11 Nov '02	12 Dec '02	12 Dec '02	12 Feb '03	25 Feb '03
<b>CONVENTIONALS</b>										
BOD (mg/L)	6.7	4.0U		4.1	5.7	12	4.0U	4.0U	5.5	7.3
COD (mg/L)	76	26		98	52	91	34	40	120	5.6
EC (umhos/cm)	200	110		100	100	150	110	110	110	130
TOC (mg/L)	20	11		5.7	9.8	13	8.4	9.2	8.5	8.3
Hardness (mg/L)	36	21J		23	22	27	24J	20	22	26
Alkalinity (mg/L)	32	18		22	19	30	50	22	27	24
Cyanide (ug/L)	5.0U	5.0U		5.0U	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U
Chloride (mg/L)	31	15		16	16	16	15	15	13	18
Fluoride (mg/L)	0.31	0.19		0.17	0.13	0.22	0.16	0.17	0.13	0.10U
TKN (mg/L)	2.7	1.3		1.2	1.0	2.7	1.7	1.4	1.3	1.3
Ammonia as N (mg/L)	0.92	0.31		0.30	0.21	0.72	0.36	0.32	0.37	0.22
Nitrite N (mg/L)	0.10U	0.10U		0.10U	0.10U	0.10U	0.10U	0.10U	0.10U	0.10U
Nitrate N (mg/L)	1.0	0.54		0.52	0.47	1.1	0.7	0.69	0.64	0.49
Total P (mg/L)	0.49	0.51		0.42	0.27	0.73	0.6	0.57	0.72	0.49
Ortho-P (Dissolved). (mg/L)	0.5	0.23		0.18	0.15	0.68	0.38	0.37	0.28	0.25
MBAS (mg/L)	0.15	0.07		0.098	0.069	0.10	0.064	0.023	0.12	0.076
MTBE (ug/L)	0.5U	0.5U	0.5U	0.5U	0.5U	0.5U	0.5U		0.5U	0.5U
Total Phenols (mg/L)	0.1U	0.1U		0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U
Oil & Grease (mg/L)	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U		5.0U	5.0U
Turbidity (NTU)	32	82		44	31	45	58	77	32	27
TRPH (mg/L)	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U		5.0U	5.0U
TSS (mg/L)	52	140		72	48	100	90	74	80	78
TDS (mg/L)	150	74		74	66	100	70	70	82	74
TVS (mg/L)	32	R		12	46	42	R	R	12	44

**Table 6.2 Stormwater Chemistry Results: City of Long Beach Storm Monitoring Project, Bouton Creek and Belmont Pump Station**  
(Page 2 of 4)

	Bouton Creek 1	Bouton Creek 2	Bouton Creek 2FD	Bouton Creek 3	Bouton Creek 4	Belmont Pump 1	Belmont Pump 2	Belmont Pump 2FD	Belmont Pump 3	Belmont Pump 4
ANALYTE	11 Nov '02	12 Dec '02	12 Dec '02	12 Feb '03	25 Feb '03	11 Nov '02	12 Dec '02	12 Dec '02	12 Feb '03	25 Feb '03
<b>BACTERIA (mpn/100ml)</b>										
Enterococcus	1140	8560	8370	57	2950	588	3390		39	3390
Fecal Coliform	11000	3000	11000	13000	11000	50000	8000		13000	13000
Total Coliform	50000	160000	90000	30000	80000	240000	>160000		160000	28000
<b>TOTAL METALS (µg/L)</b>										
Aluminum	2100	4300		2100	1200	3400	2800	2500	2000	1300
Antimony	3.7	3.1		2.2	1.6	3.2	2.8	2.6	2.9	1.9
Arsenic	2.4	2.5		2.1	1.5	2.5	2.4	2.2	2.5	1.8
Beryllium	0.50U	0.50U		0.50U	0.50U	0.50U	0.50U	0.50U	0.50U	0.50U
Cadmium	0.61	0.82		0.53	0.45	0.88	0.72	0.64	0.72	0.25U
Chromium	18	24		18	16	7.9	6.7	6.0	6.0	4.3
Hex Chromium		0.02U		0.02U	0.02U		0.02U	0.02U	0.02U	0.02U
Copper	28	35		23	17	55	33	29	34	34
Iron	2200	5100		2300	1600	3400	3800	3000	2100	2300
Mercury	0.20U	0.20U		0.20U	0.20U	0.20U	0.20U	0.20U	0.20U	0.20U
Nickel	9.4	9.8		7.9	5.6	10	6.8	6.2	6.6	5.0
Lead	16	32		20	13	40	34	30	28	28
Selenium	1.0U	1.0U		1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
Silver	0.74	0.25U		0.25	0.25U	1.5	0.25U	0.25U	0.25U	0.25U
Thallium	1.0U	1.0U		1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
Zinc	180	220J		150	100	290	220J	190J	220	190
<b>DISSOLVED METALS (µg/L)</b>										
Aluminum	180	57		71	25U	29	43	46	230	25U
Antimony	2.3	1.1		1.2	0.93	1.2	0.96	0.94	1.5	1.1
Arsenic	1.7	1.2		1.3	1.2	1.7	1.4	1.4	1.6	1.3
Beryllium	0.50U	0.50U		0.50U	0.50U	0.50U	0.50U	0.50U	0.50U	0.50U
Cadmium	0.30	0.25U		0.25U	0.25U	0.25U	0.25U	0.25U	0.25U	0.25U
Chromium	3.3	2.6		3.2	3.1	0.88	1.0	0.94	1.1	0.61
Copper	18	7.7		7.7	7.5	11	7.6	7.6	10	9.1

**Table 6.2 Stormwater Chemistry Results: City of Long Beach Storm Monitoring Project, Bouton Creek and Belmont Pump Station**  
(Page 3 of 4)

	Bouton Creek 1	Bouton Creek 2	Bouton Creek 2FD	Bouton Creek 3	Bouton Creek 4	Belmont Pump 1	Belmont Pump 2	Belmont Pump 2FD	Belmont Pump 3	Belmont Pump 4
ANALYTE	11 Nov '02	12 Dec '02	12 Dec '02	12 Feb '03	25 Feb '03	11 Nov '02	12 Dec '02	12 Dec '02	12 Feb '03	25 Feb '03
Iron	190	80		86	79	63	71	82	47	43
Mercury	0.20U	0.20U		0.20U	0.20U	0.20U	0.20U	0.20U	.020U	0.20U
Nickel	6.5	3.2		3.6	3.2	4.8	2.1	2.1	2.5	1.7
Lead	5.0	1.7		1.8	1.4	1.6	1.4	1.3	0.89	0.64
Selenium	1.0U	1.0U		1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
Silver	0.25U	0.25U		0.25U	0.25U	0.25U	0.25U	0.25U	0.25U	0.25U
Thallium	1.0U	1.0U		1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
Zinc	160	69		49	64J	100	67	75	60	63J
<b>CHLORINATED PESTICIDES (µg/L)</b>										
4,4'-DDD	0.050U	0.050U		0.050U	0.050U	0.050U	0.050U	0.050U	0.050U	0.050U
4,4'-DDE	0.050U	0.050U		0.050U	0.050U	0.050U	0.050U	0.050U	0.050U	0.050U
4,4'-DDT	0.010U	0.010U		0.010U	0.010U	0.010U	0.010U	0.010U	0.010U	0.010U
Aldrin	0.005U	0.005U		0.005U	0.005U	0.005U	0.005U	0.005U	0.005U	0.005U
alpha-BHC	0.010U	0.010U		0.010U	0.010U	0.010U	0.010U	0.010U	0.010U	0.010U
alpha-Chlordane	0.10U	0.10U		0.10U	0.10U	0.10U	0.10U	0.10U	0.10U	0.10U
alpha-Endosulfan	0.020U	0.020U		0.020U	0.020U	0.020U	0.020U	0.020U	0.020U	0.020U
beta-BHC	0.005U	0.005U		0.005U	0.005U	0.005U	0.005U	0.005U	0.005U	0.005U
beta-Endosulfan	0.010U	0.010U		0.010U	0.010U	0.010U	0.010U	0.010U	0.010U	0.010U
delta-BHC	0.005U	0.005U		0.005U	0.005U	0.005U	0.005U	0.005U	0.005U	0.005U
Endosulfan Sulfate	0.050U	0.050U		0.050U	0.050U	0.050U	0.050U	0.050U	0.050U	0.050U
Endrin	0.010U	0.010U		0.010U	0.010U	0.010U	0.010U	0.010U	0.010U	0.010U
Endrin Aldehyde	0.010U	0.010U		0.010U	0.010U	0.010U	0.010U	0.010U	0.010U	0.010U
Dieldrin	0.010U	0.010U		0.010U	0.010U	0.019	0.010U	0.010U	0.010U	0.010U
gamma-BHC	0.020U	0.020U		0.020U	0.020U	0.020U	0.020U	0.020U	0.020U	0.020U
gamma-Chlordane	0.10U	0.10U		0.10U	0.10U	0.10U	0.10U	0.10U	0.10U	0.10U
Heptachlor	0.010U	0.010U		0.010U	0.010U	0.010U	0.010U	0.010U	0.010U	0.010U
Heptachlor Epoxide	0.010U	0.010U		0.010U	0.010U	0.010U	0.010U	0.010U	0.010U	0.010U
Toxaphene	0.5U	0.5U		0.5U	0.5U	0.5U	0.5U	0.5U	0.5U	0.5U

**Table 6.2 Stormwater Chemistry Results: City of Long Beach Storm Monitoring Project, Bouton Creek and Belmont Pump Station  
(Page 4 of 4)**

	Bouton Creek 1	Bouton Creek 2	Bouton Creek 2FD	Bouton Creek 3	Bouton Creek 4	Belmont Pump 1	Belmont Pump 2	Belmont Pump 2FD	Belmont Pump 3	Belmont Pump 4
ANALYTE	11 Nov '02	12 Dec '02	12 Dec '02	12 Feb '03	25 Feb '03	11 Nov '02	12 Dec '02	12 Dec '02	12 Feb '03	25 Feb '03
<b>AROCLORS (µg/L)</b>										
Aroclor 1016	0.5U	0.5U		0.5U	0.5U	0.5U	0.5U	0.5U	0.5U	0.5U
Aroclor 1221	0.5U	0.5U		0.5U	0.5U	0.5U	0.5U	0.5U	0.5U	0.5U
Aroclor 1232	0.5U	0.5U		0.5U	0.5U	0.5U	0.5U	0.5U	0.5U	0.5U
Aroclor 1242	0.5U	0.5U		0.5U	0.5U	0.5U	0.5U	0.5U	0.5U	0.5U
Aroclor 1248	0.5U	0.5U		0.5U	0.5U	0.5U	0.5U	0.5U	0.5U	0.5U
Aroclor 1254	0.5U	0.5U		0.5U	0.5U	0.5U	0.5U	0.5U	0.5U	0.5U
Aroclor 1260	0.5U	0.5U		0.5U	0.5U	0.5U	0.5U	0.5U	0.5U	0.5U
Total PCB's	0.5U	0.5U		0.5U	0.5U	0.5U	0.5U	0.5U	0.5U	0.5U
<b>ORGANOPHOSPHATE PESTICIDES (µg/L)</b>										
Atrazine	2.0U	2.0U		1.0U	0.50U	2.0U	2.0U	2.0U	1.0U	0.50U
Chlorpyrifos	0.05U	0.05U		0.05U	0.05U	0.05U	<b>0.26Y</b>	<b>0.21Y</b>	0.05U	0.050U
Cyanazine	2.0U	2.0U		1.0U	0.50U	2.0U	2.0U	2.0U	1.0U	0.50U
Diazinon	<b>0.19Y</b>	<b>0.21</b>		<b>0.11</b>	<b>0.23Y</b>	<b>0.31</b>	<b>0.35</b>	<b>0.27</b>	<b>0.22</b>	<b>0.15Y</b>
Malathion	1.0U	1.0U		1.0U	1.0U	<b>1.1</b>	1.0U	1.0U	1.0U	1.0U
Prometryn	2.0U	2.0U		1.0U	0.50U	2.0U	2.0U	2.0U	1.0U	0.50U
Simazine	2.0U	<b>2.6</b>		1.0U	<b>3.0</b>	2.0U	2.0U	2.0U	1.0U	0.50U
<b>HERBICIDES (µg/L)</b>										
2,4,5-TP (Silvex)	0.50U	0.50U		0.50U	0.50U	0.50U	0.50U	0.50U	0.50U	0.50U
2,4-D	1.0U	1.0U		1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
Glyphosate	5.0U	5.0U		5.0U	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U

**Bolded** values indicate results that were greater than the reporting detection limit.

R<sup>1</sup> Indicates data were not valid. Data were rejected.

- Indicates analyte not tested.

Y=% Difference between primary and confirmation column is >40%.

U=Not detected at the associated value.

J=Analyte is considered an estimate, value detected below quantitation limits.

11 Nov 2002 Event - Atrazine, Cyanazine, Prometryn, Simazine and Malathion done by ToxScan.

12 Dec 2002 Event - All OP Pest done by APPL.

12 and 25 Feb 2002 Events - Prometryn, Atrazine, Simazine and Cyanazine done by ToxScan. Chlorpyrifos, Malathion and Diazinon.

16 Mar 2003 Event - All OP Pest done by ToxScan.

**Table 6.3 Stormwater Chemistry Results: City of Long Beach Storm Monitoring Project, Los Cerritos Channel and Dominguez Gap (Page 1 of 4)**

	Los Cerritos Channel 1	Los Cerritos Channel 1FD	Los Cerritos Channel 2	Los Cerritos Channel 3	Los Cerritos Channel 3FD	Los Cerritos Channel 4	Los Cerritos Channel 4FD	Dominguez Gap 1	Dominguez Gap 2	Dominguez Gap 2FD	Dominguez Gap 3	Dominguez Gap 3FD
ANALYTE	11 Nov '02	11 Nov '02	12 Dec '02	12 Feb '03	12 Feb '03	25 Feb '03	25 Feb '03	12 Feb '03	25 Feb '03	25 Feb '03	16 Mar '03	16 Mar '03
<b>CONVENTIONALS</b>												
BOD (mg/L)	4.5	8.0	4.0U	4.0U	4.0U	6.0		4.0U	4.0U	4.0U	4.8	4.9
COD (mg/L)	75	98	32	180	94	69		81	38	54	29	24
EC (umhos/cm)	120	200	97	55	54	59		210	48	48	74	74
TOC (mg/L)	19	21	13	6.7	5.7	8.0		7.8	5.8	6.0	11	10
Hardness (mg/L)	38	31	27J	17	15	21		49	14	12	17	18
Alkalinity (mg/L)	34	32	25	21	130	19		46	18	18	24	21
pH (pH units)	6.8	6.8	6.7	6.2	6.2	6.3		6.6	5.4	6.3	6.4	6.5
Cyanide (ug/L)	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U		5.0U	5.0U	5.0U	5.0U	5.0U
Chloride (mg/L)	8.2	33	9.6	3.2	3.3	4.3		26	3.4	3.3	11	5.7
Fluoride (mg/L)	0.24	0.32	0.2	0.10U	0.10U	0.10U		0.22	0.10U	0.10U	0.12	0.10U
TKN (mg/L)	2.5	2.5	2.6	1.1	1.1	1.0		2.1	0.73	0.78	1.2	1.2
Ammonia as N (mg/L)	0.90	0.92	0.51	0.29	0.29	0.29		1.1	0.29	0.16	0.39	0.36
Nitrite N (mg/L)	0.10U	0.10U	0.10U	0.10U	0.10U	0.10U		0.20	0.10U	0.10U	0.10U	0.10U
Nitrate N (mg/L)	1.1	1.1	0.72	0.47	0.47	0.46		1.0	0.30	0.31	0.38	0.37
Total P (mg/L)	0.83	0.51	1.3	0.93	0.67	0.49		0.57	0.35	0.35	0.37	0.37
Ortho-P (Dissolved). (mg/L)	0.44	0.45	0.17	0.15	0.15	0.14		0.30	0.24	0.24	0.27	0.27
MBAS (mg/L)	0.18	0.15	0.11	0.029	0.057	0.078		0.07	0.031	0.036	0.051	0.062
MTBE (ug/L)	0.5U	0.5U	0.5U	0.5U	0.5U	0.5U	0.5U	0.5U	0.5U		0.5U	0.5U
Total Phenols (mg/L)	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U		0.1U	0.1U	0.1U	0.1U	0.1U
Oil & Grease (mg/L)	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U		5.0U	5.0U
Turbidity (NTU)	48	33	140	78	74	69		14	30	28	29	30
TRPH (mg/L)	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U			
TSS (mg/L)	110	54	450	220	200	130		80	40	40	38	40
TDS (mg/L)	110	150	78	32	32	56		140	40	36	74	66
TVS (mg/L)	38	26	R	24	30	50		28	48	48	24	23

**Table 6.3 Stormwater Chemistry Results: City of Long Beach Storm Monitoring Project, Los Cerritos Channel and Dominguez Gap**  
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	Los Cerritos Channel 1	Los Cerritos Channel 1FD	Los Cerritos Channel 2	Los Cerritos Channel 3	Los Cerritos Channel 3FD	Los Cerritos Channel 4	Los Cerritos Channel 4FD	Dominguez Gap 1	Dominguez Gap 2	Dominguez Gap 2FD	Dominguez Gap 3	Dominguez Gap 3FD
ANALYTE	11 Nov '02	11 Nov '02	12 Dec '02	12 Feb '03	12 Feb '03	25 Feb '03	25 Feb '03	12 Feb '03	25 Feb '03	25 Feb '03	16 Mar '03	16 Mar '03
<b>BACTERIA (mpn/100ml)</b>												
Enterococcus	1178	1100	6670	144	225	4400	4530	26	5200		6560	6350
Fecal Coliform	11000	8000	90000	3000	8000	11000	8000	8000	30000		50000	22000
Total Coliform	80000	30000	>160000	50000	24000	>160000	>160000	90000	30000		160000	160000
<b>TOTAL METALS (µg/L)</b>												
Aluminum	2100	4600	13000	4800	4700	1400		3000	1500	580	2000	540
Antimony	3.5	3.4	6.4	1.9	1.9	1.0		1.4	0.65	0.50U	1.1	0.64
Arsenic	2.3	4.5	5.5	3.0	3.1	1.6		2.6	1.7	1.1	1.8	2
Beryllium	0.50U	0.50U	0.50U	0.50U	0.50U	0.50U		0.50U	0.50U	0.50U	0.50U	0.50U
Cadmium	0.59	2.2	2.9	1.0	1.1	0.61		0.45	0.25U	0.25U	0.25U	0.25U
Chromium	18	11	23	9.3	9.9	4.4		5.8	3.4	1.9	3.2	1.6
Hex Chromium			0.02U	0.02U	0.02U	0.02U		0.02U	0.02U	0.02U	0.02U	0.02U
Copper	27	52	91	46	26	20		20	11	9.3	11	9.3
Iron	2200	4300	12000	4000	4500	5100		2600	1900	1700	1700	1500
Mercury	0.20U	0.20U	0.20U	0.20U	0.20U	0.20U		0.20U	0.20U	0.20U	0.20U	0.20U
Nickel	9.1	15	23	8.0	8.3	5.1		6.5	3.1	2.3	3.4	2.5
Lead	16	42	120	31	32	22		19	12	10	10	8.7
Selenium	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U		1.0U	1.0U	1.0U	1.0U	1.0U
Silver	0.54	0.76	0.32	0.25U	0.25U	0.25U		0.25U	0.25U	0.25U	0.25U	0.25U
Thallium	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U		1.0U	1.0U	1.0U	1.0U	1.0U
Zinc	180	500	680J	250	500	160		140	60J	54	59	57
<b>DISSOLVED METALS (µg/L)</b>												
Aluminum	420	100	65	51	56	40		34	25	32	150	140
Antimony	2.8	2.4	2.1	1.1	1.1	0.91		0.69	0.50U	0.50U	0.6	0.61
Arsenic	2.1	1.8	1.6	1.5	1.4	1.4		1.5	1.4	1.3	1.8	1.8
Beryllium	0.50U	0.50U	0.50U	0.50U	0.50U	0.50U		0.50U	0.50U	0.50U	0.50U	0.50U
Cadmium	0.36	0.29	0.25U	0.25U	0.25U	0.25U		0.25U	0.25U	0.25U	0.25U	0.25U
Chromium	3.2	2.4	1.4	1.1	1.1	1.1		0.79	0.56	0.56	0.83	0.8
Copper	19	15	8.1	5.0	5.0	5.6		5.8	4.4	4.5	7.3	7.4
Iron	490	110	95	52	62	72		57	76	99	180	180
Mercury	0.20U	0.20U	0.20U	0.20U	0.20U	0.20U		0.20U	0.20U	0.20U	0.20U	0.20U
Nickel	7.1	6.0	2.6	1.3	1.2	1.5		2.2	1.0	1.0U	1.7	1.7
Lead	7.6	3.8	1.4	0.79	0.90	0.97		1.0	1.2	0.99	1.8	1.8
Selenium	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U		1.0U	1.0U	1.0U	1.0U	1.0U

**Table 6.3 Stormwater Chemistry Results: City of Long Beach Storm Monitoring Project, Los Cerritos Channel and Dominguez Gap**  
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	Los Cerritos Channel 1	Los Cerritos Channel 1FD	Los Cerritos Channel 2	Los Cerritos Channel 3	Los Cerritos Channel 3FD	Los Cerritos Channel 4	Los Cerritos Channel 4FD	Dominguez Gap 1	Dominguez Gap 2	Dominguez Gap 2FD	Dominguez Gap 3	Dominguez Gap 3FD
ANALYTE	11 Nov '02	11 Nov '02	12 Dec '02	12 Feb '03	12 Feb '03	25 Feb '03	25 Feb '03	12 Feb '03	25 Feb '03	25 Feb '03	16 Mar '03	16 Mar '03
Silver	0.25U	0.25U	0.25U	0.25U	0.25U	0.25U	0.25U	0.25U	0.25U	0.25U	0.25U	0.25U
Thallium	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
Zinc	160	140	60	35	33	63J		37	41J	46J	39J	38J
<b>CHLORINATED PESTICIDES (µg/L)</b>												
4,4'-DDD	0.050U	0.050U	0.050U	0.050U	0.050U	0.050U		0.050U	0.050U	0.050U	0.050U	0.050U
4,4'-DDE	0.050U	0.050U	0.050U	0.050U	0.050U	0.050U		0.050U	0.050U	0.050U	0.050U	0.050U
4,4'-DDT	0.010U	0.010U	0.010U	0.010U	0.010U	0.010U		0.010U	0.010U	0.010U	0.010U	0.010U
Aldrin	0.005U	0.005U	0.005U	0.005U	0.005U	0.005U		0.005U	0.005U	0.005U	0.005U	0.005U
alpha-BHC	0.010U	0.010U	0.010U	0.010U	0.010U	0.010U		0.010U	0.010U	0.010U	0.010U	0.010U
alpha-Chlordane	0.10U	0.10U	0.10U	0.10U	0.10U	0.10U		0.10U	0.10U	0.10U	0.10U	0.10U
alpha-Endosulfan	0.020U	0.020U	0.020U	0.020U	0.020U	0.020U		0.020U	0.020U	0.020U	0.020U	0.020U
beta-BHC	0.005U	0.005U	0.005U	0.005U	0.005U	0.005U		0.005U	0.005U	0.005U	0.005U	0.005U
beta-Endosulfan	0.010U	0.010U	0.010U	0.010U	0.010U	0.010U		0.010U	0.010U	0.010U	0.010U	0.010U
delta-BHC	0.005U	0.005U	0.005U	0.005U	0.005U	0.005U		0.005U	0.005U	0.005U	0.005U	0.005U
Endosulfan Sulfate	0.050U	0.050U	0.050U	0.050U	0.050U	0.050U		0.050U	0.050U	0.050U	0.050U	0.050U
Endrin	0.010U	0.010U	0.010U	0.010U	0.010U	0.010U		0.010U	0.010U	0.010U	0.010U	0.010U
Endrin Aldehyde	0.010U	0.010U	0.010U	0.010U	0.010U	0.010U		0.010U	0.010U	0.010U	0.010U	0.010U
Dieldrin	0.016	0.021	0.010U	0.010U	0.010U	0.010U		0.010U	0.010U	0.010U	0.010U	0.010U
gamma-BHC	0.020U	0.020U	0.12	0.020U	0.020U	0.020U		0.020U	0.020U	0.020U	0.020U	0.020U
gamma-Chlordane	0.10U	0.10U	0.10U	0.10U	0.10U	0.10U		0.10U	0.10U	0.10U	0.10U	0.10U
Heptachlor	0.010U	0.010U	0.010U	0.010U	0.010U	0.010U		0.010U	0.010U	0.010U	0.010U	0.010U
Heptachlor Epoxide	0.010U	0.010U	0.010U	0.010U	0.010U	0.010U		0.010U	0.010U	0.010U	0.010U	0.010U
Toxaphene	0.5U	0.5U	0.5U	0.5U	0.5U	0.5U		0.5U	0.5U	0.5U	0.5U	0.5U
<b>AROCLORS (µg/L)</b>												
Aroclor 1016	0.5U	0.5U	0.5U	0.5U	0.5U	0.5U		0.5U	0.5U	0.5U	0.5U	0.5U
Aroclor 1221	0.5U	0.5U	0.5U	0.5U	0.5U	0.5U		0.5U	0.5U	0.5U	0.5U	0.5U
Aroclor 1232	0.5U	0.5U	0.5U	0.5U	0.5U	0.5U		0.5U	0.5U	0.5U	0.5U	0.5U
Aroclor 1242	0.5U	0.5U	0.5U	0.5U	0.5U	0.5U		0.5U	0.5U	0.5U	0.5U	0.5U
Aroclor 1248	0.5U	0.5U	0.5U	0.5U	0.5U	0.5U		0.5U	0.5U	0.5U	0.5U	0.5U
Aroclor 1254	0.5U	0.5U	0.5U	0.5U	0.5U	0.5U		0.5U	0.5U	0.5U	0.5U	0.5U
Aroclor 1260	0.5U	0.5U	0.5U	0.5U	0.5U	0.5U		0.5U	0.5U	0.5U	0.5U	0.5U
Total PCB's	0.5U	0.5U	0.5U	0.5U	0.5U	0.5U		0.5U	0.5U	0.5U	0.5U	0.5U

**Table 6.3 Stormwater Chemistry Results: City of Long Beach Storm Monitoring Project, Los Cerritos Channel and Dominguez Gap (Page 4 of 4)**

	Los Cerritos Channel 1	Los Cerritos Channel 1FD	Los Cerritos Channel 2	Los Cerritos Channel 3	Los Cerritos Channel 3FD	Los Cerritos Channel 4	Los Cerritos Channel 4FD	Dominguez Gap 1	Dominguez Gap 2	Dominguez Gap 2FD	Dominguez Gap 3	Dominguez Gap 3FD
ANALYTE	11 Nov '02	11 Nov '02	12 Dec '02	12 Feb '03	12 Feb '03	25 Feb '03	25 Feb '03	12 Feb '03	25 Feb '03	25 Feb '03	16 Mar '03	16 Mar '03
<b>ORGANOPHOSPHATE PESTICIDES (µg/L)</b>												
Atrazine	2.0U	2.0U	2.0U	1.0U	1.0U	0.50U		1.0U	0.50U	0.50U	1.0U	1.0U
Chlorpyrifos	<b>0.25Y</b>	0.05U	0.05U	0.05U	0.05U	0.05U		0.05U	0.05U	0.05U	0.05U	0.062U
Cyanazine	2.0U	2.0U	2.0U	1.0U	1.0U	0.50U		1.0U	0.50U	0.50U	1.0U	1.0U
Diazinon	<b>0.27Y</b>	<b>0.20Y</b>	<b>0.25</b>	<b>0.11</b>	<b>0.12</b>	<b>0.13Y</b>		<b>0.09</b>	<b>0.14Y</b>	<b>0.10Y</b>	<b>0.023</b>	<b>0.023</b>
Malathion	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U		1.0U	1.0U	1.0U	1.0U	1.2U
Prometryn	2.0U	2.0U	2.0U	1.0U	1.0U	0.50U		1.0U	0.50U	0.50U	1.0U	1.0U
Simazine	2.0U	2.0U	<b>27</b>	1.0U	1.0U	<b>2.4</b>		1.0U	<b>1.4</b>	<b>1.5</b>	<b>1.8</b>	<b>1.4</b>
<b>HERBICIDES (µg/L)</b>												
2,4,5-TP (Silvex)	0.50U	0.50U	0.50U	0.50U	0.50U	0.50U		0.50U	0.50U	0.50U	0.50U	0.50U
2,4-D	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U		1.0U	1.0U	1.0U	1.0U	1.0U
Glyphosate	5.2U	5.0U	5.0U	5.0U	5.0U	5.0U		5.0U	5.0U	5.0U	5.0U	5.0U

**Bolded** values indicate results that were greater than the reporting detection limit.

R<sup>1</sup> Indicates data were not valid. Data were rejected.

- Indicates analyte not tested.

Y=% Difference between primary and confirmation column is >40%. U=Not detected at the associated value. J=Analyte is considered an estimate, value detected below quantitation limits.

11 Nov 2002 Event - Atrazine, Cyanazine, Prometryn, Simazine and Malathion done by ToxScan.

12 Dec 2002 Event - All OP Pest done by APPL.

12 and 25 Feb 2002 Events - Prometryn, Atrazine, Simazine and Cyanazine done by ToxScan. Chlorpyrifos, Malathion and Diazinon.

16 Mar 2003 Event - All OP Pest done by ToxScan.

**Table 6.4 Load Calculations (pounds) for each Storm Event at Bouton Creek**

Analyte	ML <sup>1</sup>	11/8/2002 Bouton Creek	12/12/2002 Bouton Creek	2/12/2003 Bouton Creek	2/25/2003 Bouton Creek
<b><i>Conventional</i></b>					
BOD	4 mg/L	1830	0	2517	1036
COD	4 mg/L	20753	615	60158	9453
TOC	1 mg/L	5461	2583	3499	1782
Hardness	1 mg/L	9830	4884	14119	3999
Alkalinity	5 mg/L	8738	4226	13505	3454
Cyanide	5 ug/L	0	0	0	0
Chloride	1 mg/L	8465	3522	9822	2909
Fluoride	0.1 mg/L	85	45	104	24
TKN	0.1 mg/L	737	35	737	182
NH3-N	0.1 mg/L	251	72	184	38
NO2-N (Nitrite)	0.1 mg/L	0	0	0	0
NO3-N (Nitrate)	0.1 mg/L	273	127	319	85
P (Total)	0.05 mg/L	134	120	258	49
Ortho-P (Dissolved)	0.01 mg/L	137	54	110	27
MBAS (Surfactants)	0.02 mg/L	41	16	60	13
MTBE	0.05 ug/L	0	0	0	0
Total Phenols	0.01 mg/L	0	0	0	0
Oil & Grease	5 mg/L	0	0	0	0
TRPH	5 mg/L	0	0	0	0
TSS	1 mg/L	14199	3288	44197	8726
TDS	1 mg/L	40959	17375	45425	11998
<b><i>Total Metals</i></b>					
Al	25 ug/L	573	845	1289	218
Sb	0.5 ug/L	1.0	0.73	1.4	0.29
As	0.5 ug/L	0.66	0.59	1.3	0.27
Be	0.5 ug/L	0	0	0	0
Cd	0.25 ug/L	0.17	0.19	0.33	0.082
Cr	0.5 ug/L	4.9	5.6	11	2.9
Cr(VI)	0.3-1 mg/L		0	0	0
Cu	0.5 ug/L	7.6	8.2	14	3.1
Fe	25 ug/L	601	1197	1412	291
Hg	0.2 ug/L	0	0	0	0
Ni	1 ug/L	2.6	2.3	4.8	1.0
Pb	0.5 ug/L	4.4	7.5	12	2.4
Se	1 ug/L	0	0	0	0
Ag	0.25 ug/L	0.20	0	0.15	0
Tl	1 ug/L	0	0	0	0
Zn	1 ug/L	49	52	92	18

**Table 6.4 Load Calculations (pounds) for each Storm Event at Bouton Creek. (continued)**

Analyte	ML <sup>1</sup>	11/8/2002 Bouton Creek	12/12/2002 Bouton Creek	2/12/2003 Bouton Creek	2/25/2003 Bouton Creek
<b><i>Dissolved Metals</i></b>					
Al	25 ug/L	49	13	44	0
Sb	0.5 ug/L	0.63	0.26	0.74	0.17
As	0.5 ug/L	0.46	0.28	0.80	0.22
Be	0.5 ug/L	0	0	0	0
Cd	0.25 ug/L	0.082	0	0	0
Cr	0.5 ug/L	0.90	0.61	2.0	0.56
Cu	0.5 ug/L	4.9	1.8	4.7	1.4
Fe	25 ug/L	52	19	53	14
Hg	0.2 ug/L	0	0	0	0
Ni	1 ug/L	1.8	0.75	2.2	0.58
Pb	0.5 ug/L	1.4	0.40	1.1	0.25
Se	1 ug/L	0	0	0	0
Ag	0.25 ug/L	0	0	0	0
Tl	1 ug/L	0	0	0	0
Zn	1 ug/L	44	16	30	12
<b><i>Chlorinated Pesticides</i></b>					
4,4'-DDD	0.05 ug/L	0	0	0	0
4,4'-DDE	0.05 ug/L	0	0	0	0
4,4'-DDT	0.01 ug/L	0	0	0	0
Aldrin	0.005 ug/L	0	0	0	0
alpha-BHC	0.01 ug/L	0	0	0	0
alpha-Chlordane	0.1 ug/L	0	0	0	0
alpha-Endosulfan	0.1 ug/L	0	0	0	0
beta-BHC	0.005 ug/L	0	0	0	0
beta-Endosulfan	0.01 ug/L	0	0	0	0
delta-BHC	0.005 ug/L	0	0	0	0
Endosulfan Sulfate	0.05 ug/L	0	0	0	0
Endrin	0.01 ug/L	0	0	0	0
Endrin Aldehyde	0.01 ug/L	0	0	0	0
Dieldrin	0.01 ug/L	0	0	0	0
gamma-BHC	0.02 ug/L	0	0	0	0
gamma-Chlordane	0.01 ug/L	0	0	0	0
Heptachlor	0.01 ug/L	0	0	0	0
Heptachlor Epoxide	0.01 ug/L	0	0	0	0
Toxaphene	0.5 ug/L	0	0	0	0
<b><i>Aroclors</i></b>					
Aroclor 1016	0.5 ug/L	0	0	0	0
Aroclor 1221	0.5 ug/L	0	0	0	0
Aroclor 1232	0.5 ug/L	0	0	0	0
Aroclor 1242	0.5 ug/L	0	0	0	0
Aroclor 1248	0.5 ug/L	0	0	0	0
Aroclor 1254	0.5 ug/L	0	0	0	0
Aroclor 1260	0.5 ug/L	0	0	0	0
Total PCB's	0.5 ug/L	0	0	0	0

**Table 6.4 Load Calculations (pounds) for each Storm Event at Bouton Creek. (continued)**

<b>Analyte</b>	<b>ML<sup>1</sup></b>	<b>11/8/2002 Bouton Creek</b>	<b>12/12/2002 Bouton Creek</b>	<b>2/12/2003 Bouton Creek</b>	<b>2/25/2003 Bouton Creek</b>
<b><i>Organophosphates</i></b>					
Atrazine	1 ug/L	0	0	0	0
Chlorpyrifos	0.05 ug/L	0	0	0	0
Cyanazine	1 ug/L	0	0	0	0
Diazinon	0.01 ug/L	0.052	0.049	0.07	0.042
Malathion	1 ug/L	0	0	0	0
Prometryn	1 ug/L	0	0	0	0
Simazine	1 ug/L	0	0.61	0	0.55
<b><i>Chorinated Herbicides</i></b>					
2,4,5-TP (Silvex)	0.05 ug/L	0	0	0	0
2,4-D	1 ug/L	0	0	0	0
Glyphosate	5 ug/L	1.1	0	0	0

1. ML = Minimum Level as defined in the State Implementation Plan.

Notes:

A "0" indicates that an analysis was performed but the analyte was not detected. A blank cell indicates that the analysis was not performed.

**Table 6.5 Load Calculations (pounds) for each Storm Event at the Belmont Pump Station.**

		11/8/2002	12/12/2002	2/12/2003	2/25/2003
Analyte	ML <sup>1</sup>	Belmont Pump	Belmont Pump	Belmont Pump	Belmont Pump
<i>Conventionals</i>					
BOD	4 mg/L	48	0	276	118
COD	4 mg/L	361	534	6027	91
TOC	1 mg/L	52	132	427	134
Hardness	1 mg/L	107	374	1105	420
Alkalinity	5 mg/L	119	786	1356	388
Cyanide	5 ug/L	0	0	0	0
Chloride	1 mg/L	64	236	653	291
Fluoride	0.1 mg/L	0.87	2.5	6.5	0
TKN	0.1 mg/L	11	27	65	21
NH3-N	0.1 mg/L	2.9	5.6	19	3.6
NO2-N (Nitrite)	0.1 mg/L	0	0	0	0
NO3-N (Nitrate)	0.1 mg/L	4.37	11	32	7.9
P (Total)	0.05 mg/L	2.90	9.4	36	7.9
Ortho-P (Dissolved)	0.01 mg/L	2.70	6.0	14	4.0
MBAS (Surfactants)	0.02 mg/L	0.40	1.0	6.0	0
MTBE	0.05 ug/L	0	0	0	0
Total Phenols	0.01 mg/L	0	0	0	0
Oil & Grease	5 mg/L	0	0	0	0
TRPH	5 mg/L	0	0	0	0
TSS	1 mg/L	397	1414	4018	1261
TDS	1 mg/L	397	1100	4119	1196
<i>Total Metals</i>					
Al	25 ug/L	13	36	100	21
Sb	0.5 ug/L	0.013	0.044	0.15	0.031
As	0.5 ug/L	0.010	0.038	0.13	0.029
Be	0.5 ug/L	0	0	0	0
Cd	0.25 ug/L	0.0035	0.011	0.04	0
Cr	0.5 ug/L	0.031	0.11	0.30	0.070
Cr(VI)	0.3-1 mg/L		0	0	0
Cu	0.5 ug/L	0.22	0.52	1.7	0.55
Fe	25 ug/L	13	60	105	37
Hg	0.2 ug/L	0	0	0	0
Ni	1 ug/L	0.040	0.11	0.33	0.081
Pb	0.5 ug/L	0.16	0.53	1.4	0.45
Se	1 ug/L	0	0	0	0
Ag	0.25 ug/L	0	0	0	0
Tl	1 ug/L	0	0	0	0
Zn	1 ug/L	1.2	3.5	11	3.1

**Table 6.5 Load Calculations (pounds) for each Storm Event at the Belmont Pump Station.**  
(continued)

Analyte	ML <sup>1</sup>	11/8/2002 Belmont Pump	12/12/2002 Belmont Pump	2/12/2003 Belmont Pump	2/25/2003 Belmont Pump
<b><i>Dissolved Metals</i></b>					
Al	25 ug/L	0.12	0.68	12	0
Sb	0.5 ug/L	0.0048	0.015	0.075	0.018
As	0.5 ug/L	0.0067	0.022	0.080	0.021
Be	0.5 ug/L	0.0020	0	0	0
Cd	0.25 ug/L	0	0	0	0
Cr	0.5 ug/L	0.0035	0.02	0.06	0.010
Cu	0.5 ug/L	0.044	0.12	0.50	0.15
Fe	25 ug/L	0.25	1.1	2.4	0.70
Hg	0.2 ug/L	0	0	0	0
Ni	1 ug/L	0.02	0.033	0.13	0.027
Pb	0.5 ug/L	0.01	0.022	0.045	0.010
Se	1 ug/L	0	0	0	0
Ag	0.25 ug/L	0	0	0	0
Tl	1 ug/L	0	0	0	0
Zn	1 ug/L	0.40	1.1	3.0	1.0
<b><i>Chlorinated Pesticides</i></b>					
4,4'-DDD	0.05 ug/L	0	0	0	0
4,4'-DDE	0.05 ug/L	0	0	0	0
4,4'-DDT	0.01 ug/L	0	0	0	0
Aldrin	0.005 ug/L	0	0	0	0
alpha-BHC	0.01 ug/L	0	0	0	0
alpha-Chlordane	0.1 ug/L	0	0	0	0
alpha-Endosulfan	0.1 ug/L	0	0	0	0
beta-BHC	0.005 ug/L	0	0	0	0
beta-Endosulfan	0.01 ug/L	0	0	0	0
delta-BHC	0.005 ug/L	0	0	0	0
Endosulfan Sulfate	0.05 ug/L	0	0	0	0
Endrin	0.01 ug/L	0	0	0	0
Endrin Aldehyde	0.01 ug/L	0	0	0	0
Dieldrin	0.01 ug/L	0.000075	0	0	0
gamma-BHC	0.02 ug/L	0	0	0	0
gamma-Chlordane	0.01 ug/L	0	0	0	0
Heptachlor	0.01 ug/L	0	0	0	0
Heptachlor Epoxide	0.01 ug/L	0	0	0	0
Toxaphene	0.5 ug/L	0	0	0	0
<b><i>Aroclors</i></b>					
Aroclor 1016	0.5 ug/L	0	0	0	0
Aroclor 1221	0.5 ug/L	0	0	0	0
Aroclor 1232	0.5 ug/L	0	0	0	0
Aroclor 1242	0.5 ug/L	0	0	0	0
Aroclor 1248	0.5 ug/L	0	0	0	0
Aroclor 1254	0.5 ug/L	0	0	0	0
Aroclor 1260	0.5 ug/L	0	0	0	0
Total PCB's	0.5 ug/L	0	0	0	0

**Table 6.5 Load Calculations (pounds) for each Storm Event at the Belmont Pump Station.  
(continued)**

Analyte	ML <sup>1</sup>	11/8/2002 Belmont Pump	12/12/2002 Belmont Pump	2/12/2003 Belmont Pump	2/25/2003 Belmont Pump
<b><i>Organophosphates</i></b>					
Atrazine	1 ug/L	0	0	0	0
Chlorpyrifos	0.05 ug/L	0	0	0	0
Cyanazine	1 ug/L	0	0	0	0
Diazinon	0.01 ug/L	0.0012	0.0055	0.14	0.0024
Malathion	1 ug/L	0.0044	0	0	0
Prometryn	1 ug/L	0	0	0	0
Simazine	1 ug/L	0	0	0	0
<b><i>Chorinated Herbicides</i></b>					
2,4,5-TP (Silvex)	0.05 ug/L	0	0	0	0
2,4-D	1 ug/L	0	0	0	0
Glyphosate	0.05 ug/L	0.016	0	0	0

1. ML = Minimum Level as defined in the State Implementation Plan.

Notes:

A "0" indicates that an analysis was performed but the analyte was not detected. A blank cell indicates that the analysis was not performed.

**Table 6.6 Load Calculations (pounds) for each Storm Event at Los Cerritos Channel.**

<b>Analyte</b>	<b>ML<sup>1</sup></b>	<b>11/8/2002 Los Cerritos Channel</b>	<b>12/12/2002 Los Cerritos Channel</b>	<b>2/12/2003 Los Cerritos Channel</b>	<b>2/25/2003 Los Cerritos Channel</b>
<b><i>Conventionals</i></b>					
BOD	4 mg/L	3770	0	0	4277
COD	4 mg/L	62838	50128	533557	49183
TOC	1 mg/L	15919	20365	19860	5702
Hardness	1 mg/L	31838	41826	50391	14969
Alkalinity	5 mg/L	28487	39163	62248	13543
Cyanide	5 ug/L	0	0	0	0
Chloride	1 mg/L	6870	15038	9485	3065
Fluoride	0.1 mg/L	201	313	0	0
TKN	0.1 mg/L	2095	4073	3261	713
NH3-N	0.1 mg/L	754	799	860	207
NO2-N (Nitrite)	0.1 mg/L	0	0	0	0
NO3-N (Nitrate)	0.1 mg/L	922	1128	1393	328
P (Total)	0.05 mg/L	695	2036	2757	349
Ortho-P (Dissolved)	0.01 mg/L	369	266	445	100
MBAS (Surfactants)	0.02 mg/L	151	172	86	56
MTBE	0.05 ug/L	0	0	0	0
Total Phenols	0.01 mg/L	0	0	0	0
Oil & Grease	5 mg/L	0	0	0	0
TRPH	5 mg/L	0	0	0	0
TSS	1 mg/L	92163	704927	652125	92664
TDS	1 mg/L	92163	122187	94855	39917
<b><i>Total Metals</i></b>					
Al	25 ug/L	1759	15665	14228	998
Sb	0.5 ug/L	2.9	10	5.6	0.71
As	0.5 ug/L	1.9	8.6	8.9	1.1
Be	0.5 ug/L	0	0	0	0
Cd	0.25 ug/L	0.49	4.5	3.0	0.43
Cr	0.5 ug/L	15	36	28	3.1
Cr(VI)	0.3-1 mg/L		0	0	0
Cu	0.5 ug/L	22.6	143	136	14
Fe	25 ug/L	1843	18799	11857	3635
Hg	0.2 ug/L	0.00	0	0	0
Ni	1 ug/L	7.6	36	24	3.6
Pb	0.5 ug/L	13	188	92	16
Se	1 ug/L	0	0	0	0
Ag	0.25 ug/L	0.45	0.50	0	0
Tl	1 ug/L	0	0	0	0
Zn	1 ug/L	151	1065	741	114

**Table 6.6 Load Calculations (pounds) for each Storm Event at Los Cerritos Channel.**  
(continued)

Analyte	ML <sup>1</sup>	11/8/2002 Los Cerritos Channel	12/12/2002 Los Cerritos Channel	2/12/2003 Los Cerritos Channel	2/25/2003 Los Cerritos Channel
<i><b>Dissolved Metals</b></i>					
Al	25 ug/L	352	102	151	29
Sb	0.5 ug/L	2.3	3.3	3.3	0.65
As	0.5 ug/L	1.8	2.5	4.4	1.0
Be	0.5 ug/L	0	0	0	0
Cd	0.25 ug/L	0.30	0	0	0
Cr	0.5 ug/L	2.7	2.2	3.3	0.78
Cu	0.5 ug/L	16	13	15	4.0
Fe	25 ug/L	411	149	154	51
Hg	0.2 ug/L	0	0	0	0
Ni	1 ug/L	5.9	4.1	3.9	1.1
Pb	0.5 ug/L	6.4	2.2	2.3	0.69
Se	1 ug/L	0	0	0	0
Ag	0.25 ug/L	0	0	0	0
Tl	1 ug/L	0	0	0	0
Zn	1 ug/L	134	94	104	45
<i><b>Chlorinated Pesticides</b></i>					
4,4'-DDD	0.05 ug/L	0	0	0	0
4,4'-DDE	0.05 ug/L	0	0	0	0
4,4'-DDT	0.01 ug/L	0	0	0	0
Aldrin	0.005 ug/L	0	0	0	0
alpha-BHC	0.01 ug/L	0	0	0	0
alpha-Chlordane	0.1 ug/L	0	0	0	0
alpha-Endosulfan	0.1 ug/L	0	0	0	0
beta-BHC	0.005 ug/L	0	0	0	0
beta-Endosulfan	0.01 ug/L	0	0	0	0
delta-BHC	0.005 ug/L	0	0	0	0
Endosulfan Sulfate	0.05 ug/L	0	0	0	0
Endrin	0.01 ug/L	0	0	0	0
Endrin Aldehyde	0.01 ug/L	0	0	0	0
Dieldrin	0.01 ug/L	0.013	0	0	0
gamma-BHC	0.02 ug/L	0	0.19	0	0
gamma-Chlordane	0.01 ug/L	0	0	0	0
Heptachlor	0.01 ug/L	0	0	0	0
Heptachlor Epoxide	0.01 ug/L	0	0	0	0
Toxaphene	0.5 ug/L	0	0	0	0
<i><b>Aroclors</b></i>					
Aroclor 1016	0.5 ug/L	0	0	0	0
Aroclor 1221	0.5 ug/L	0	0	0	0
Aroclor 1232	0.5 ug/L	0	0	0	0
Aroclor 1242	0.5 ug/L	0	0	0	0
Aroclor 1248	0.5 ug/L	0	0	0	0
Aroclor 1254	0.5 ug/L	0	0	0	0
Aroclor 1260	0.5 ug/L	0	0	0	0
Total PCB's	0.5 ug/L	0	0	0	0

**Table 6.6 Load Calculations (pounds) for each Storm Event at Los Cerritos Channel.**  
(continued)

Analyte	ML <sup>1</sup>	11/8/2002 Los Cerritos Channel	12/12/2002 Los Cerritos Channel	2/12/2003 Los Cerritos Channel	2/25/2003 Los Cerritos Channel
<b><i>Organophosphates</i></b>					
Atrazine	1 ug/L	0	0	0	0
Chlorpyrifos	0.05 ug/L	0.21	0	0	0
Cyanazine	1 ug/L	0	0	0	0
Diazinon	0.01 ug/L	0.23	0.39	0.0055	0.093
Malathion	1 ug/L	0	0	0	0
Prometryn	1 ug/L	0	0	0	0
Simazine	1 ug/L	0	42	0	1.7
<b><i>Chorinated Herbicides</i></b>					
2,4,5-TP (Silvex)	0.05 ug/L	0	0	0	0
2,4-D	1 ug/L	0	0	0	0
Glyphosate	5 ug/L	4.4	0	0	0

1. ML = Minimum Level as defined in the State Implementation Plan.

Notes:

A "0" indicates that an analysis was performed but the analyte was not detected. A blank cell indicates that the analysis was not performed.

**Table 6.7 Load Calculations (pounds) for each Storm Event at the Dominguez Pump Station.**

<b>Analyte</b>	<b>ML<sup>1</sup></b>	<b>2/12/2003 Dominguez</b>	<b>2/25/2003 Dominguez</b>	<b>3/16/2003 Dominguez</b>
<b><i>Conventionals</i></b>				
BOD	4 mg/L	0	0	253
COD	4 mg/L	22826	2005	1530
TOC	1 mg/L	2198	306	580
Hardness	1 mg/L	13808	739	918
Alkalinity	5 mg/L	12963	950	1266
Cyanide	5 ug/L	0	0	0
Chloride	1 mg/L	7327	179	580
Fluoride	0.1 mg/L	62	0	6.3
TKN	0.1 mg/L	592	39	63
NH3-N	0.1 mg/L	310	15	21
NO2-N (Nitrite)	0.1 mg/L	56	0	0
NO3-N (Nitrate)	0.1 mg/L	282	16	20
P (Total)	0.05 mg/L	161	18	20
Ortho-P (Dissolved)	0.01 mg/L	85	13	14
MBAS (Surfactants)	0.02 mg/L	20	1.6	2.7
MTBE	0.05 ug/L	0	0	0
Total Phenols	0.01 mg/L	0	0	0
Oil & Grease	5 mg/L	0	0	0
TRPH	5 mg/L	0	0	0
TSS	1 mg/L	22544	2110	2005
TDS	1 mg/L	39452	2110	3904
<b><i>Total Metals</i></b>				
Al	25 ug/L	845	79	106
Sb	0.5 ug/L	0.39	0.034	0.058
As	0.5 ug/L	0.73	0.090	0.095
Be	0.5 ug/L	0	0	0
Cd	0.25 ug/L	0.13	0	0
Cr	0.5 ug/L	1.6	0.18	0.17
Cr(VI)	0.3-1 mg/L	0	0	0
Cu	0.5 ug/L	5.6	0.58	0.58
Fe	25 ug/L	733	100	90
Hg	0.2 ug/L	0	0	0
Ni	1 ug/L	1.8	0.16	0.18
Pb	0.5 ug/L	5.4	0.63	0.53
Se	1 ug/L	0	0	0
Ag	0.25 ug/L	0	0	0
Tl	1 ug/L	0	0	0
Zn	1 ug/L	39	3.2	3.1

**Table 6.7 Load Calculations (pounds) for each Storm Event at the Dominguez Pump Station.  
(continued)**

<b>Analyte</b>	<b>ML<sup>1</sup></b>	<b>2/12/2003 Dominguez</b>	<b>2/25/2003 Dominguez</b>	<b>3/16/2003 Dominguez</b>
<b><i>Dissolved Metals</i></b>				
Al	25 ug/L	10	1.7	7.9
Sb	0.5 ug/L	0.19	0	0.032
As	0.5 ug/L	0.42	0.069	0.095
Be	0.5 ug/L	0	0	0
Cd	0.25 ug/L	0	0	0
Cr	0.5 ug/L	0.22	0.030	0.044
Cu	0.5 ug/L	1.6	0.24	0.39
Fe	25 ug/L	16	5.2	9.5
Hg	0.2 ug/L	0	0	0
Ni	1 ug/L	0.62	0	0.090
Pb	0.5 ug/L	0.28	0.052	0.095
Se	1 ug/L	0	0	0
Ag	0.25 ug/L	0	0	0
Tl	1 ug/L	0	0	0
Zn	1 ug/L	10	2.4	2.1
<b><i>Chlorinated Pesticides</i></b>				
4,4'-DDD	0.05 ug/L	0	0	0
4,4'-DDE	0.05 ug/L	0	0	0
4,4'-DDT	0.01 ug/L	0	0	0
Aldrin	0.005 ug/L	0	0	0
alpha-BHC	0.01 ug/L	0	0	0
alpha-Chlordane	0.1 ug/L	0	0	0
alpha-Endosulfan	0.1 ug/L	0	0	0
beta-BHC	0.005 ug/L	0	0	0
beta-Endosulfan	0.01 ug/L	0	0	0
delta-BHC	0.005 ug/L	0	0	0
Endosulfan Sulfate	0.05 ug/L	0	0	0
Endrin	0.01 ug/L	0	0	0
Endrin Aldehyde	0.01 ug/L	0	0	0
Dieldrin	0.01 ug/L	0	0	0
gamma-BHC	0.02 ug/L	0	0	0
gamma-Chlordane	0.01 ug/L	0	0	0
Heptachlor	0.01 ug/L	0	0	0
Heptachlor Epoxide	0.01 ug/L	0	0	0
Toxaphene	0.5 ug/L	0	0	0
<b><i>Aroclors</i></b>				
Aroclor 1016	0.5 ug/L	0	0	0
Aroclor 1221	0.5 ug/L	0	0	0
Aroclor 1232	0.5 ug/L	0	0	0
Aroclor 1242	0.5 ug/L	0	0	0
Aroclor 1248	0.5 ug/L	0	0	0
Aroclor 1254	0.5 ug/L	0	0	0
Aroclor 1260	0.5 ug/L	0	0	0
Total PCB's	0.5 ug/L	0	0	0

**Table 6.7 Load Calculations (pounds) for each Storm Event at the Dominguez Pump Station.  
(continued)**

<b>Analyte</b>	<b>ML<sup>1</sup></b>	<b>2/12/2003 Dominguez</b>	<b>2/25/2003 Dominguez</b>	<b>3/16/2003 Dominguez</b>
<b><i>Organophosphates</i></b>				
Atrazine	1 ug/L	0	0	0
Chlorpyrifos	0.05 ug/L	0	0	0
Cyanazine	1 ug/L	0	0	0
Diazinon	0.01 ug/L	0.27	0.0053	0.0012
Malathion	1 ug/L	0	0	0
Prometryn	1 ug/L	0	0	0
Simazine	1 ug/L	0	0.079	0.095
<b><i>Chorinated Herbicides</i></b>				
2,4,5-TP (Silvex)	0.05 ug/L	0	0	0
2,4-D	1 ug/L	0	0	0
Glyphosate	0.05 ug/L	0	0	0

1. ML = Minimum Level as defined in the State Implementation Plan.

Notes:

A "0" indicates that an analysis was performed but the analyte was not detected. A blank cell indicates that the analysis was not performed.

**Table 6.8 Monitored Dry Weather Events, 1999-2003**

Station	Event 1 10/4/00	Event 2 6/21/00	Event 3 6/29/00	Event 4 6/5/01	Event 5 8/16/01	Event 6 5/9,14/02	Event 7 9/5/02	Event 8 5/20/03
Bouton Creek		X	X	X	X	X	X	X
Belmont Pump		X	X	X	X	X	X	X
Los Cerritos Channel				X	X	X	X	X
Dominguez Gap		X <sup>1</sup>	X <sup>1</sup>	X <sup>1</sup>	X <sup>1</sup>	X <sup>1</sup>	X <sup>1</sup>	X <sup>1</sup>
Alamitos Bay	X	X	X	X	X	X		

1 Intake to basin was observed to be dry. Therefore, no samples were collected.  
Shading indicates 2002-2003 Dry Weather Surveys included in this report.

**Table 6.9 Field Measurements for Bouton Creek, Belmont Pump, and Los Cerritos Channel, Dry Weather Season (2002/2003).**

	Bouton Creek		Belmont Pump		Los Cerritos	
Date	9/05/02	5/20/03	9/05/02	5/20/03	9/05/02	5/20/03
Time	05:00	09:50	07:30	10:43	06:30	10:00
Temperature (°C)	21.0	18.9	22.6	19.2	20.9	21.1
pH	7.64	8.48	7.97	8.25	8.40	8.29
Conductivity (mS/cm)	9.95	3.00	2.44	2.20	8.84	0.564
Flow (cfs)	1.04 <sup>1</sup>	3.5 <sup>1</sup>	2.02 <sup>2</sup>	2.49 <sup>2</sup>	0.625 <sup>1</sup>	7.1 <sup>1</sup>
Dissolved Oxygen (mg/L)	7	13	9	13	8	15

1 Flow was determined by measuring the depth and width of the water channel, as well as the velocity of a floating object in the water.  
2 The flow rate was determined by observing changes in water level in the sump area over a 24-hour period.

**Table 6.10 Dry Weather Chemistry Results: City of Long Beach Storm Monitoring Project. (Page 1 of 5)**

ANALYTE	Belmont Pump	Los Cerritos Channel	Bouton Creek	Bouton Creek FD	Belmont Pump	Los Cerritos Channel	Bouton Creek	Bouton Creek FD
	05 Sept. '02	05 Sept. '02	05 Sept. '02	05 Sept. '02	20 May '03	20 May '03	20 May '03	20 May '03
<b>CONVENTIONALS</b>								
Biochemical Oxygen Demand (mg/L)	5U	16	5U	5U	10U	10U	10U	10U
Chemical Oxygen Demand (mg/L)	88	210	380	300	86	160	210	230
Total Organic Carbon (mg/L)	9.6	45	19	19	9.3	18	7.2	12
Specific Conductance (umhos/cm)	3,100	1,400	14,000	14,000	3000	1200	7600	7300
Total Hardness (mg/L)	350	180	1,500	1,600	372	154	580	684
Alkalinity, as CaCO3 (mg/L)	420	150	150	150	420	130	180	180
pH (units)	8.43	9.34	7.77	7.77	8.10	9.41	9.01	9.03
Cyanide (ug/L)	5U	5U	5U	5U	5U	5U	5U	5U
Chloride (mg/L)	760	190	4700	4500	760	290	2900	2600
Fluoride (mg/L)	1.9	1.1	2.3	1.8	1.3	0.80	1.1	1.0
Total Kjeldahl Nitrogen (mg/L)	1.2	0.70	3.5	1.1	1.7	4.3	2.3	2.6
Total Ammonia-Nitrogen (mg/L)	0.11	0.17	0.13	0.27	0.43	0.16	0.10	0.14
Nitrite Nitrogen (mg/L)	0.20U	0.10U	1.0U	1.0U	0.10U	0.10U	0.10U	0.10U
Nitrate Nitrogen (mg/L)	1.2	0.10U	1.0U	1.0U	1.1	0.10U	0.10U	0.10U
Total Nitrogen	2.4	0.70	3.5	1.1	2.8	4.3	2.3	2.6
Total Phosphorus (mg/L)	0.67	0.61	0.029	0.18	0.91	0.15	0.63	0.59
Dissolved Phosphorus (mg/L)	0.77	0.015	0.015	0.013	0.73	0.01U	0.01U	0.10U
MBAS (mg/L)	0.03	0.059	0.043	0.043	0.048	0.051	0.052	0.033
MTBE (ug/L)	0.5U	0.5U	0.5U	0.5U	0.5U	0.5U	0.5U	0.5U
Total Phenols (mg/L)	0.10U	0.10U	0.10U	0.10U	0.10U	0.10U	0.10U	0.10U
Oil & Grease (mg/L)	5U	5U	5U	5U	5U	5U	5U	5U
TRPH (mg/L)	5U	5U	5U	5U	5U	5U	5U	5U
Total Suspended Solids (mg/L)	4	18	10	10	6	4	152	146
Total Dissolved Solids (mg/L)	1,800	680	8,600	8,700	1770	736	4670	4630
Turbidity (NTU)	1.7	12	4.4	6.4	11	6.8	30	43
Total Volatile Solids (mg/L)	1U	1U	1.1	1U	110	72	586	558
<b>BACTERIA (mpn/100ml)</b>								
Fecal Coliform	30,000	8,000	1,300	8,000	7,000	30,000	9,000	3,000
Enterococcus	2,880	3,300	1,370	1,160	2,020	20,300	1,220	600
Total Coliform	80,000	24,000	5,000	24,000	17,000	>160,000	13,000	8,000

**Bolded** values indicate results that were greater than the reporting detection limit.

U – Indicates that data were not detected at the associated detection limit.

R<sup>1</sup> Indicates data were not valid. Data were rejected.

- Analyte not tested

**Table 6.10 Dry Weather Chemistry Results: City of Long Beach Storm Monitoring Project. (Page 2 of 5)**

ANALYTE	Belmont Pump	Los Cerritos Channel	Bouton Creek	Bouton Creek FD	Belmont Pump	Los Cerritos Channel	Bouton Creek	Bouton Creek FD
	05 Sept. '02	05 Sept. '02	05 Sept. '02	05 Sept. '02	20 May '03	20 May '03	20 May '03	20 May '03
<b>TOTAL METALS (ug/L)</b>								
Aluminum	25U	25U	25U	25U	<b>260</b>	<b>48</b>	<b>2500</b>	<b>2400</b>
Antimony	<b>0.72</b>	<b>1.7</b>	<b>2.4</b>	<b>1.7</b>	<b>0.70</b>	<b>1.3</b>	<b>0.78</b>	<b>0.83</b>
Arsenic	<b>4.9</b>	<b>5.4</b>	<b>6.9</b>	<b>7.2</b>	<b>4.6</b>	<b>7.5</b>	<b>6.5</b>	<b>6.3</b>
Beryllium	0.5U	0.5U	0.5U	0.5U	0.5U	0.5U	0.5U	0.5U
Cadmium	0.25U	0.25U	0.25U	0.25U	0.25U	<b>0.44</b>	<b>0.33</b>	<b>0.32</b>
Chromium	<b>0.8</b>	<b>0.75</b>	<b>6.7</b>	<b>5.1</b>	<b>1.8</b>	<b>0.87</b>	<b>7.0</b>	<b>6.6</b>
Hexavalent Chromium	20U	20U	20U	20U	0.3U	<b>0.3</b>	0.3U	0.3U
Copper	<b>4.3</b>	<b>10</b>	<b>17</b>	<b>16</b>	<b>5.5</b>	<b>16</b>	<b>25</b>	<b>29</b>
Iron	<b>720</b>	<b>110</b>	<b>100</b>	<b>53</b>	<b>450</b>	<b>100</b>	<b>3400</b>	<b>3100</b>
Mercury	0.2U	0.2U	0.2U	0.2U	0.01U	0.01U	<b>0.013</b>	0.01U
Nickel	<b>3.1</b>	<b>5.5</b>	<b>3.9</b>	<b>4</b>	<b>3.6</b>	<b>4.6</b>	<b>6.3</b>	<b>5.9</b>
Lead	<b>0.92</b>	<b>1.2</b>	<b>2.6</b>	<b>2.7</b>	<b>2.5</b>	<b>1.3</b>	<b>22</b>	<b>23</b>
Selenium	<b>3.8</b>	<b>1.5</b>	<b>22</b>	<b>24</b>	<b>5.1</b>	<b>1.8</b>	<b>15</b>	<b>16</b>
Silver	0.25U	0.25U	<b>2.0R</b>	<b>0.29R</b>	0.25U	0.25U	<b>0.54</b>	<b>0.5</b>
Thallium	1U	1U	1U	1U	1U	1U	1U	1U
Zinc	<b>12</b>	<b>12</b>	<b>28</b>	<b>28</b>	<b>20</b>	<b>13</b>	<b>110</b>	<b>100</b>
<b>DISSOLVED METALS (ug/L)</b>								
Aluminum	25U	25U	25U	25U	25U	<b>45</b>	<b>38</b>	25U
Antimony	<b>0.52</b>	<b>1.4</b>	<b>1.1</b>	<b>1.1</b>	<b>0.61</b>	<b>1.4</b>	<b>0.74</b>	<b>0.73</b>
Arsenic	<b>3.6</b>	<b>4.4</b>	<b>5.6</b>	<b>6.0</b>	<b>5.2</b>	<b>8.5</b>	<b>5.7</b>	<b>6.1</b>
Beryllium	0.5U	0.5U	0.5U	0.5U	0.5U	0.5U	0.5U	0.5U
Cadmium	0.25U	0.25U	0.25U	0.25U	0.25U	<b>0.43</b>	0.25U	0.25U
Chromium	<b>0.79</b>	<b>0.64</b>	<b>0.94</b>	<b>1.1</b>	<b>1.9</b>	<b>0.95</b>	<b>1.5</b>	<b>1.2</b>
Copper	<b>2.2</b>	<b>6.7</b>	<b>6.9</b>	<b>7.4</b>	<b>2.9</b>	<b>14</b>	<b>11</b>	<b>9.9</b>
Iron	<b>40</b>	25U	25U	25U	<b>54</b>	25U	<b>38</b>	25U
Mercury	0.2U	0.2U	0.2U	0.2U	0.01U	0.01U	0.01U	0.01U
Nickel	<b>2.3</b>	<b>4.3</b>	<b>2.7</b>	<b>2.9</b>	<b>3.0</b>	<b>3.9</b>	<b>2.3</b>	<b>2.3</b>
Lead	0.5U	<b>0.58</b>	<b>1.3</b>	<b>1.4</b>	<b>0.57</b>	<b>1.2</b>	<b>1.6</b>	<b>1.4</b>
Selenium	<b>2.8</b>	<b>1.4</b>	<b>19</b>	<b>20</b>	<b>5.7</b>	<b>2.2</b>	<b>16</b>	<b>14</b>
Silver	0.25U	0.25U	0.25U	0.25U	0.25U	0.25U	<b>0.53</b>	0.25U
Thallium	1U	1U	1U	1U	1U	1U	1U	1U
Zinc	<b>6.9</b>	<b>9.0</b>	<b>25</b>	<b>27</b>	<b>9.5</b>	<b>19</b>	<b>14</b>	<b>20</b>

**Bolded** values indicate results that were greater than the reporting detection limit.

R<sup>1</sup> Indicates data were not valid. Data were rejected.

- Analyte not tested

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**Table 6.10 Dry Weather Chemistry Results: City of Long Beach Storm Monitoring Project. (Page 3 of 5)**

ANALYTE	Belmont Pump	Los Cerritos Channel	Bouton Creek	Bouton Creek FD	Belmont Pump	Los Cerritos Channel	Bouton Creek	Bouton Creek FD
	05 Sept. '02	05 Sept. '02	05 Sept. '02	05 Sept. '02	20 May '03	20 May '03	20 May '03	20 May '03
<b>CHLORINATED PESTICIDES (ug/L)</b>								
4,4'-DDD	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U
4,4'-DDE	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U
4,4'-DDT	0.01U	0.01U	0.01U	0.01U	0.01U	0.01U	0.01U	0.01U
Aldrin	0.05U	0.05U	0.05U	0.05U	0.005U	0.005U	0.005U	0.005U
alpha-BHC	0.05U	0.05U	0.05U	0.05U	0.01U	0.01U	0.01U	0.01U
alpha-Chlordane	0.5U	0.5U	0.5U	0.5U	0.1U	0.1U	0.1U	0.1U
beta-BHC	0.05U	0.05U	0.05U	0.05U	0.005U	0.005U	0.005U	0.005U
delta-BHC	0.05U	0.05U	0.05U	0.05U	0.005U	0.005U	0.005U	0.005U
Dieldrin	0.01U	0.01U	0.01U	0.01U	0.01U	0.01U	0.01U	0.01U
Endosulfan I	0.05U	0.05U	0.05U	0.05U	0.02U	0.02U	0.02U	0.02U
Endosulfan II	0.05U	0.05U	0.05U	0.05U	0.01U	0.01U	0.01U	0.01U
Endosulfan Sulfate	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U
Endrin	0.01U	0.01U	0.01U	0.01U	0.01U	0.01U	0.01U	0.01U
Endrin Aldehyde	0.01U	0.01U	0.01U	0.01U	0.01U	0.01U	0.01U	0.01U
gamma-BHC (lindane)	0.05U	0.05U	0.05U	0.05U	0.02U	0.02U	0.02U	0.02U
gamma-Chlordane	0.5U	0.5U	0.5U	0.5U	0.1U	0.1U	0.1U	0.1U
Heptachlor	0.01U	0.01U	0.01U	0.01U	0.01U	0.01U	0.01U	0.01U
Heptachlor Epoxide	0.01U	0.01U	0.01U	0.01U	0.01U	0.01U	0.01U	0.01U
Toxaphene	1U	1U	1U	1U	0.5U	0.5U	0.5U	0.5U
<b>AROCLORS (ug/L)</b>								
Aroclor 1016	1U	1U	1U	1U	0.50U	0.50U	0.50U	0.50U
Aroclor 1221	1U	1U	1U	1U	0.50U	0.50U	0.50U	0.50U
Aroclor 1232	1U	1U	1U	1U	0.50U	0.50U	0.50U	0.50U
Aroclor 1242	1U	1U	1U	1U	0.50U	0.50U	0.50U	0.50U
Aroclor 1248	1U	1U	1U	1U	0.50U	0.50U	0.50U	0.50U
Aroclor 1254	1U	1U	1U	1U	0.50U	0.50U	0.50U	0.50U
Aroclor 1260	1U	1U	1U	1U	0.50U	0.50U	0.50U	0.50U
Total PCBs	1U	1U	1U	1U	0.50U	0.50U	0.50U	0.50U
Atrazine	1U	1U	1U	1U	2U	2U	2U	2U
Dursban (chlorpyrifos)	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U
Cyanazine	1U	1U	1U	1U	2U	2U	2U	2U
Diazinon	<b>0.05</b>	0.01U	0.01U	0.01U	0.05U	0.05U	0.05U	0.05U
Malathion	1U	1U	1U	1U	1U	1U	1U	1U
Prometryn	1U	1U	1U	1U	2U	2U	2U	2U
Simazine	1U	1U	1U	1U	2U	2U	2U	2U

**Bolded** values indicate results that were greater than the reporting detection limit.

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**Table 6.10 Dry Weather Chemistry Results: City of Long Beach Storm Monitoring Project. (Page 4 of 5)**

ANALYTE	Belmont Pump	Los Cerritos Channel	Bouton Creek	Bouton Creek FD	Belmont Pump	Los Cerritos Channel	Bouton Creek	Bouton Creek FD
	05 Sept. '02	05 Sept. '02	05 Sept. '02	05 Sept. '02	20 May '03	20 May '03	20 May '03	20 May '03
<b>HERBICIDES (µg/L)</b>								
2,4,5-TP (Silvex)	0.5U	0.5U	0.5U	0.5U	0.5U	0.5U	0.5U	0.5U
2,4-D	1U	1U	1U	1U	1U	<b>5.9</b>	1U	1U
Glyphosate	5U	5U	5U	5U	4J	5U	5U	5U
<b>SEMI-VOLATILES (µg/L)</b>								
1,2,4-Trichlorobenzene	1U	1U	1U	1U	-	-	-	-
1,2-Dichlorobenzene	1U	1U	1U	1U	-	-	-	-
1,2-Diphenylhydrazine	1U	1U	1U	1U	-	-	-	-
1,3-Dichlorobenzene	1U	1U	1U	1U	-	-	-	-
1,4-Dichlorobenzene	1U	1U	1U	1U	-	-	-	-
2,4,6-Trichlorophenol	1U	1U	1U	1U	-	-	-	-
2,4-Dichlorophenol	2U	2U	2U	2U	-	-	-	-
2,4-Dimethylphenol	1U	1U	1U	1U	-	-	-	-
2,4-Dinitrophenol	5U	5U	5U	5U	-	-	-	-
2,4-Dinitrotoluene	1U	1U	1U	1U	-	-	-	-
2,6-Dinitrotoluene	1U	1U	1U	1U	-	-	-	-
2-Chloroethylvinyl ether	-	-	-	-	-	-	-	-
2-Chloronaphthalene	1U	1U	1U	1U	-	-	-	-
2-Chlorophenol	2U	2U	2U	2U	-	-	-	-
2-Nitrophenol	1U	1U	1U	1U	-	-	-	-
3,3'-Dichlorobenzidine	1U	1U	1U	1U	-	-	-	-
4,6 Dinitro-2-methylphenol	2U	2U	2U	2U	-	-	-	-
4-Bromophenyl Phenyl Ether	1U	1U	1U	1U	-	-	-	-
4-Chloro-3-methylphenol	1U	1U	1U	1U	-	-	-	-
4-Chlorophenyl Phenyl Ether	1U	1U	1U	1U	-	-	-	-
4-Nitrophenol	1U	<b>1</b>	1U	1U	-	-	-	-
Acenaphthene	1U	1U	1U	1U	-	-	-	-
Acenaphthylene	1U	1U	1U	1U	-	-	-	-
Anthracene	1U	1U	1U	1U	-	-	-	-
Benzidine	1U	1U	1U	1U	-	-	-	-
Benzo(a)Anthracene	1U	1U	1U	1U	-	-	-	-
Benzo(a)Pyrene	1U	1U	1U	1U	-	-	-	-
Benzo(b)Fluoranthene	1U	1U	1U	1U	-	-	-	-
Benzo(ghi)Perylene	1U	1U	1U	1U	-	-	-	-
Benzo(k)Fluoranthene	1U	1U	1U	1U	-	-	-	-

**Bolded** values indicate results that were greater than the reporting detection limit.

R<sup>1</sup> Indicates data were not valid. Data were rejected.

- Analyte not tested

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**Table 6.10. Dry Weather Chemistry Results: City of Long Beach Storm Monitoring Project. (Page 5 of 5)**

ANALYTE	Belmont Pump	Los Cerritos Channel	Bouton Creek	Bouton Creek FD	Belmont Pump	Los Cerritos Channel	Bouton Creek	Bouton Creek FD
	05 Sept. '02	05 Sept. '02	05 Sept. '02	05 Sept. '02	20 May '03	20 May '03	20 May '03	20 May '03
<b>SEMIVOLATILES (µg/L)</b>								
Bis(2-chloroethoxy)Methane	2U	2U	2U	2U	-	-	-	-
Bis(2-chloroethyl)Ether	1U	1U	1U	1U	-	-	-	-
Bis(2-chloroisopropyl)Ether	1U	1U	1U	1U	-	-	-	-
Bis(2-Ethylhexyl)Phthalate	1U	1U	1U	1U	-	-	-	-
Butylbenzyl Phthalate	1U	1U	1U	1U	-	-	-	-
Chrysene	1U	1U	1U	1U	-	-	-	-
Dibenzo(a,h)Anthracene	1U	1U	1U	1U	-	-	-	-
Diethyl Phthalate	1U	1U	1U	1U	-	-	-	-
Dimethyl Phthalate	1U	1U	1U	1U	-	-	-	-
Di-n-Butyl Phthalate	1U	1U	1U	1U	-	-	-	-
Di-n-Octyl Phthalate	1U	1U	1U	1U	-	-	-	-
Fluoranthene	1U	1U	1U	1U	-	-	-	-
Fluorene	1U	1U	1U	1U	-	-	-	-
Hexachlorobenzene	1U	1U	1U	1U	-	-	-	-
Hexachlorobutadiene	1U	1U	1U	1U	-	-	-	-
Hexachlorocyclopentadiene	1U	1U	1U	1U	-	-	-	-
Hexachloroethane	1U	1U	1U	1U	-	-	-	-
Indeno(1,2,3-c,d)Pyrene	1U	1U	1U	1U	-	-	-	-
Isophorone	1U	1U	1U	1U	-	-	-	-
Naphthalene	1U	1U	1U	1U	-	-	-	-
Nitrobenzene	1U	1U	1U	1U	-	-	-	-
N-Nitrosodimethylamine	-	-	-	-	-	-	-	-
N-Nitrosodi-n-Propylamine	5U	5U	5U	5U	-	-	-	-
N-Nitrosodiphenylamine	1U	1U	1U	1U	-	-	-	-
Pentachlorophenol	1U	1U	1U	1U	-	-	-	-
Phenanthrene	1U	1U	1U	1U	-	-	-	-
Pyrene	1U	1U	1U	1U	-	-	-	-
Phenol	1U	1U	1U	1U	-	-	-	-

**Bolded** values indicate results that were greater than the reporting detection limit.

R<sup>1</sup> Indicates data were not valid. Data were rejected.

- Analyte not tested

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## **7.0 TOXICITY RESULTS**

Toxicity tests were conducted on subsamples of the composites collected for chemical analysis. Wet weather samples were collected from four storm events: November 8-9, 2002, December 16-17, 2002, February 12-13, 2003 and February 25, 2003. Composite samples were collected during separate storm events and were tested with either two or three species. The water flea (freshwater crustacean), mysid (marine crustacean), and sea urchin (marine echinoderm) were used on the first storm sample, and only the water flea and sea urchin were used on the final three storm samples.

Dry weather sampling occurred on September 5, 2002 and May 20, 2003.

### **7.1 Wet Weather Discharge**

The following sections describe the results of toxicity testing at each of the mass emission station. Toxicity tests were conducted on water from all four storm events at the Belmont Pump Station, Bouton Creek and the Los Cerritos Channel. A single sample was obtained from the Dominguez Gap Pump Station during the third storm.

#### **7.1.1 Belmont Pump**

The first sample from the Belmont Pump Station was collected on November 8, 2002. This sample caused toxic effects to all three test species (Table 7.1), with the fertilization test being the most sensitive, showing 8 TUC (Figure 7.1). Both the water flea survival and reproduction endpoints showed the presence of toxicity (4 TUC) with the survival endpoint slightly more sensitive (Figure 7.1). Both mysid survival and growth, were adversely affected by the sample.

The second Belmont Pump Station sample was collected on December 16 2002 and produced toxic responses in water fleas but not in sea urchins.. The water flea test was the most sensitive indicator of toxicity with a NOEC of 50% sample ( 2 TUC) and 73% sample calculated to cause a 50% reduction in survival (Table 7.1). Significant reductions in water flea survival and reproduction were found only at the 100% concentration. Water flea survival showed a greater degree of response than did the reproduction endpoint (Figure 7.1).

The third Belmont Pump Station sample was collected on February 12, 2003 and produced no toxic responses in either water flea survival/reproduction or sea urchin fertilization (Table 7.1 and Figure 7.1).

The fourth Belmont Pump Station sample was collected on February 25, 2003. This sample produced no toxic responses in either water flea survival/reproduction or sea urchin fertilization (Table 7.1 and Figure 7.1).

#### **7.1.2 Bouton Creek**

The first sample from the Bouton Creek station was collected on November 9, 2001. Toxicity to this sample was detected by sea urchins but not by water fleas or mysids (Table 7.2). Sea urchin egg fertilization was by far the most sensitive test method, with 16 TUC (Figure 7.2).

The second Bouton Creek sample was collected on December 17, 2002 and caused a toxic response (4 TUC) to sea urchins but no toxicity to water fleas (Table 7.2 and Figure 7.2).

The third Bouton Creek sample was collected on February 13, 2003 and produced no toxic responses in either water flea survival/reproduction or sea urchin fertilization (Table 7.2 and Figure 7.2).

The fourth Bouton Creek sample was collected on February 25, 2003 and produced no toxic response in water flea survival/reproduction but produced a marked reduction in sea urchin fertilization, with a NOEC of 3.125%, and 32 TUc (Table 7.2 and Figure 7.2).

### **7.1.3 Los Cerritos Channel**

The first sample from the Los Cerritos Channel station was collected on November 9, 2002. This sample caused a toxic response in all three test species (Table 7.3 and Figure 7.3). The sea urchin was the most sensitive of the three species, with a NOEC of 6.25% (16 TUc) and an EC50 of 29.5%. Both endpoints (survival and reproduction) in the water flea bioassay showed the presence of toxicity (4 TUc) as did both survival and growth of the mysid.

The second Los Cerritos Channel sample was collected on December 16, 2002 and elicited a toxic response from the water flea survival and reproduction test (NOEC = 50%, 2 TUc) but no toxicity was demonstrated in the sea urchin fertilization test (NOEC = >50%, Table 7.3).

The third Los Cerritos Channel sample was collected on February 12, 2003. A toxic response was seen in the sea urchin fertilization test (NOEC = 25%, 4 TUc), but no toxicity was produced to either survival or reproduction in the water flea bioassay (Table 7.3).

The fourth storm sample was collected from Los Cerritos Channel on February 25, 2003, and produced no toxic responses in either water flea survival/reproduction or sea urchin fertilization (Table 7.3 and Figure 7.3).

### **7.1.4 Dominguez Gap**

The sampling station at Dominguez Gap was triggered only during the third storm, and the sample was collected on February 12, 2003. Bioassay testing produced no toxic responses in either water flea survival/reproduction or sea urchin fertilization (Table 7.4 and Figure 7.4).

## **7.2 Toxicity Identification Evaluations (TIEs) of Stormwater**

The trigger for performing a TIE was modified prior to the 2002/2003 wet season. A TIE was initiated when a LC50 of  $\leq 50\%$  (equivalent to  $\geq 2$  acute TU) was obtained for the water flea or mysid test, or an EC50 of  $\leq 50\%$  ( $\geq 2$  acute TU) was obtained for the sea urchin fertilization test. This TIE trigger was exceeded 4 times among the tests conducted on four wet weather samples (Table 7.5). Of the three species, only tests conducted with water fleas and urchins exceeded the TIE trigger.

During the monitoring period, TIEs were triggered only for the first wet weather sampling event. TIEs were initiated on samples from Belmont Pump and Los Cerritos Channel for the water flea test, and on the Bouton Creek and Los Cerritos Channel samples for the sea urchin test. A reduction in toxicity relative to the initial test result was obtained for all four TIEs, resulting in a baseline toxicity of less than 2 TU, which prompted termination of these TIEs. However, despite the weak TIE signals available, some evidence of toxicant identity was obtained by inspection of the raw TIE data sets along with their statistical evaluation.

### **7.2.1 Belmont Pump Station**

The results of the TIE conducted on the November 8 sample from the Belmont pump station are summarized in Figure 7.5. Extraction of the sample using a C18 column was highly effective in reducing toxicity in the water flea test. PBO treatment also eliminated the toxicity. Increased toxicity was present in the blank for the STS treatment. The increase in toxicity of the Belmont pump sample seen after this treatment (Figure 7.5) is an artifact of this blank toxicity and confounds the interpretation of this portion of the results. The effectiveness of the C18 treatment and elimination of toxicity obtained with the PBO treatment suggest that a nonpolar organic, probably an organophosphate (OP) pesticide, is a likely toxicant of concern in this sample.

### **7.2.2 Bouton Creek Station**

One TIE was conducted on stormwater from Bouton Creek. The November 9<sup>th</sup> sample was tested using the sea urchin fertilization test. The TIE results obtained for this sample showed that addition of EDTA eliminated the toxicity of the sample. Addition of STS, centrifugation, and extraction using a C18 column did not have a substantial impact on the toxicity of this sample. This suggests that divalent cationic metals were likely toxicants in this sample.

### **7.2.3 Los Cerritos Channel Station**

A TIE was conducted on stormwater collected on November 9<sup>th</sup> from the Los Cerritos Channel site. The sea urchin fertilization test was used for this TIE. The results obtained for this sample showed addition of EDTA and STS eliminated the toxicity of the sample. Extraction using a C18 column reduced toxicity by about 20%. Centrifugation did not have a substantial impact on the toxicity of this sample. These results suggest that divalent metals were the most likely toxicants of concern in this sample.

### **7.2.4 Dominguez Gap Pump Station**

No TIEs were conducted on samples from the Dominguez Gap Pump Station during this monitoring period.

## **7.3 Dry Weather Discharge**

Toxicity tests were conducted on samples from two dry weather sampling events, on September 5, 2002 and May 20, 2003. The Bouton Creek sample collected in September 2002 contained 8.7 g/kg salinity, which was more than twice the LC50 for the fresh water organism (water flea), and this sample was not tested with the water flea. In the May 2003 sampling, the salinity of the Bouton Creek sample was 5 g/kg, approximately 1.6X the published LC50. The water flea was tested with the less saline September sample, but the results were interpreted with awareness of the probable contribution of salinity to observed toxicity at Bouton Creek.

### **7.3.1 Belmont Pump Station**

In September 2002 the undiluted Belmont Pump sample did not produce measurably decreased survival in the water flea, but did produce decreased reproduction; the NOEC for reproduction was 50% (2 TUc). The Belmont Pump Station sample was not toxic to sea urchins (Table 7.6).

The May 2003 dry weather sample produced no toxic responses in either water flea survival/reproduction or sea urchin fertilization (Table 7.6 and Figure 7.6).

### **7.3.2 Bouton Creek**

The September 2002 Bouton Creek sample was not tested with the water flea due to elevated sample salinity. Significant toxicity to sea urchins (NOEC = 12.5%) was demonstrated in the September sample.

In May 2003, the Bouton Creek dry weather sample produced toxicity to water flea survival (NOEC=50%) and reproduction (NOEC=25%). Bouton Creek sample also produced severe toxicity (NOEC=<3.1%) to sea urchins in May. Note that the toxicity to water fleas may have been exacerbated by salinity stress in this freshwater organism.

### **7.3.3 Los Cerritos Channel**

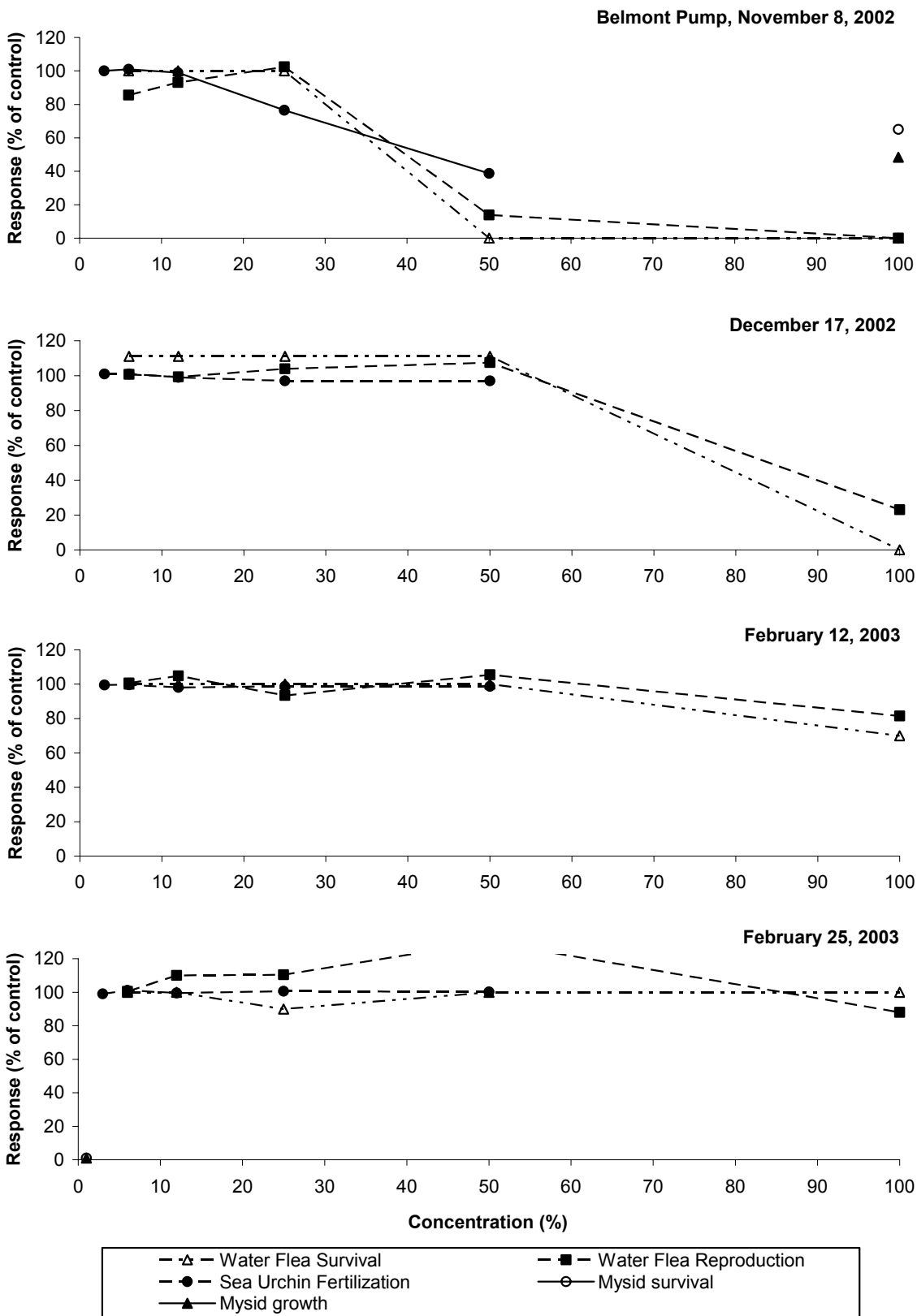
Both of the Los Cerritos dry weather samples were toxic to both water fleas and sea urchins. The September 2002 sample produced NOECs of 50% and 25% in water flea survival and reproduction (TUC ranging from 2 to 4), and a NOEC of 6.25% (16 TUC) in sea urchin fertilization.

The May 2003 Los Cerritos Channel dry weather sample was more toxic to both species, showing NOECs of 25% and 12.5% in water flea survival and reproduction (4-8 TUC) and a NOEC of <3.1% (>32 TUC) in sea urchin fertilization.

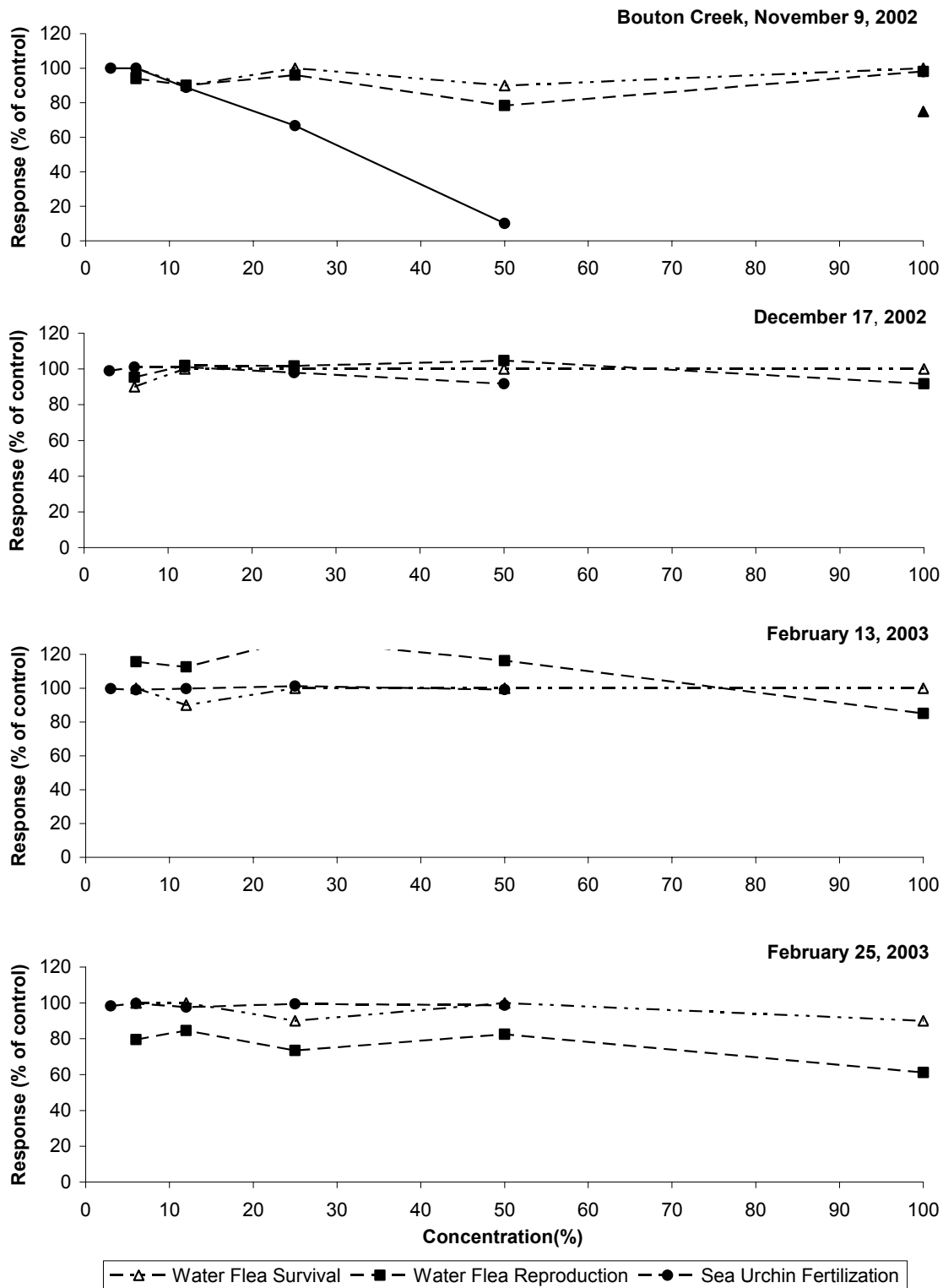
## **7.4 Dry Weather Toxicity Identification Evaluations**

A sea urchin TIE was initiated on the September 5 2002 dry weather sample from Los Cerritos station. Marginally sufficient baseline toxicity was present in the sample to complete the TIE. The toxicity of the Los Cerritos sample was slightly reduced by addition of EDTA (Figure 7.7). The remaining treatments did not alter the toxicity of the sample. The pattern of response of the sea urchin sperm to the TIE treatments is consistent with the presence of toxic concentrations of divalent trace metals.

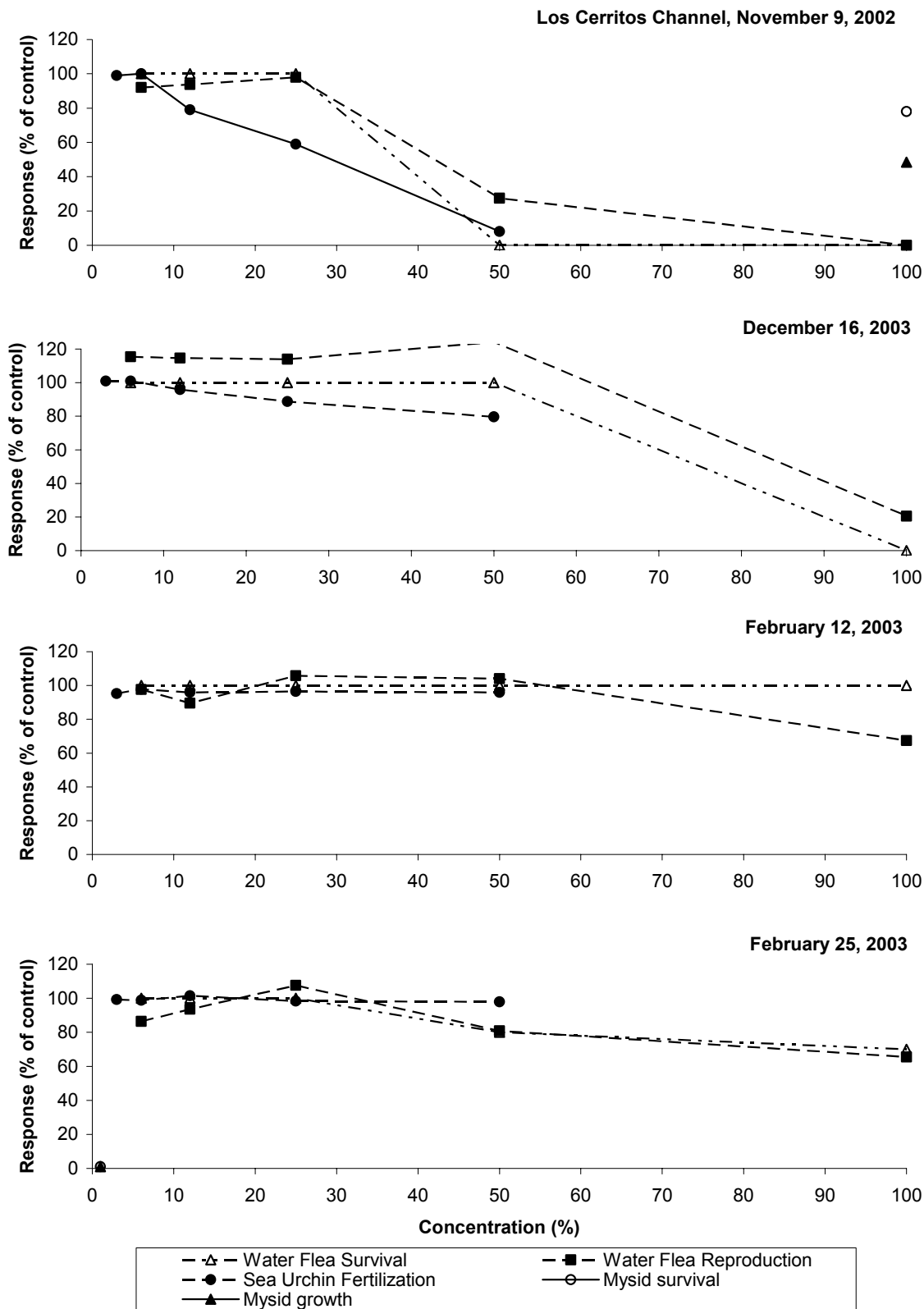
Limited TIE treatments were also incorporated into the sea urchin bioassays of the dry weather samples from Belmont Pump, Bouton Creek and Los Cerritos Channel stations of 20 May 2003. Only the highest (50%) concentration of each sample was manipulated with the addition of EDTA and STS. In the Bouton Creek and Los Cerritos Channel samples EDTA reduced toxicity (increased fertilization success) by 79.9% and 62.1%, respectively. Treatment with STS did not substantially affect toxicity in either of the samples. As above, this response pattern is consistent with the presence of toxic concentrations of divalent trace metals. The Belmont Pump Station did not produce sufficient toxicity to warrant analysis of the TIE treatments.



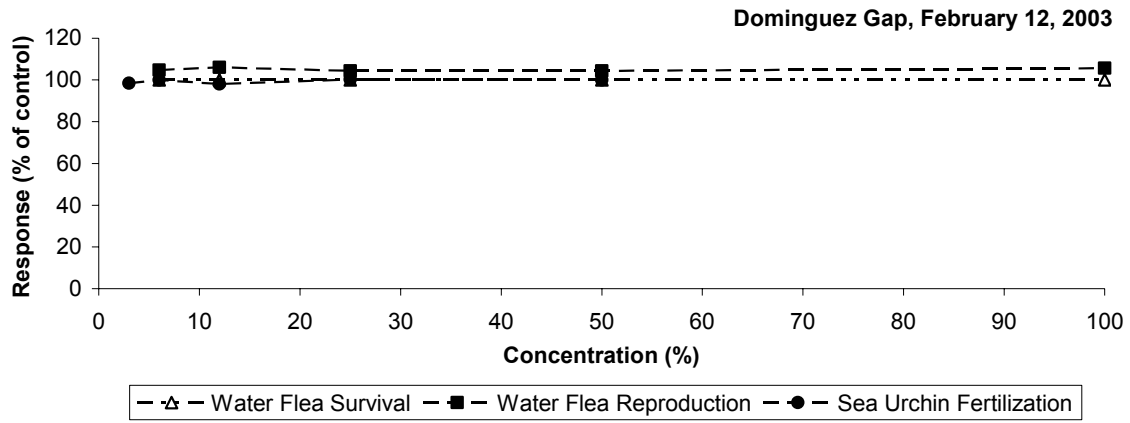
**Figure 7.1. Toxicity Dose Response Plots for Storm Water Samples Collected from Belmont Pump.**



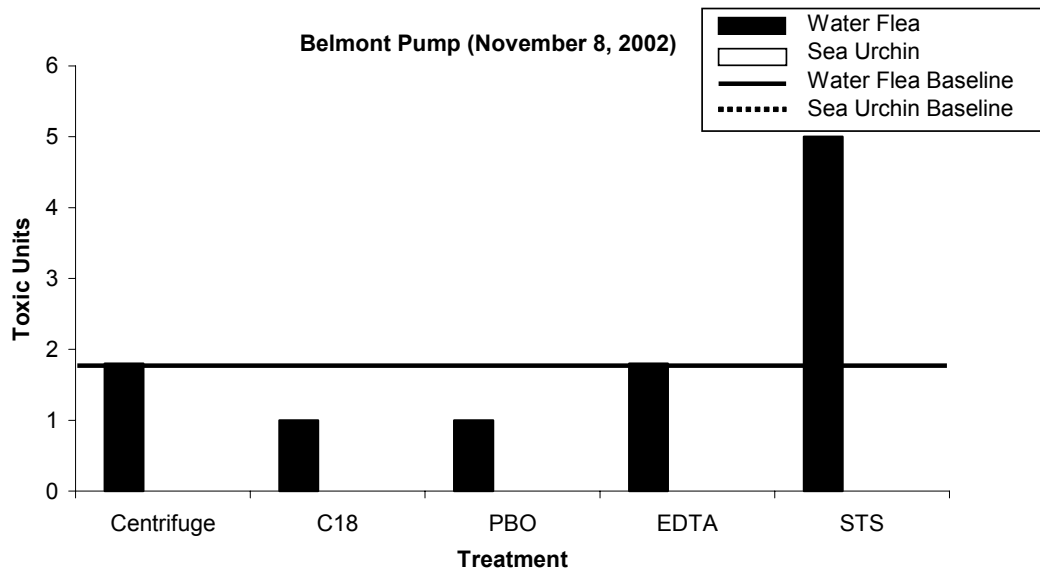
**Figure 7.2. Toxicity Dose Response Plots for Storm Water Samples Collected from Bouton Creek.**



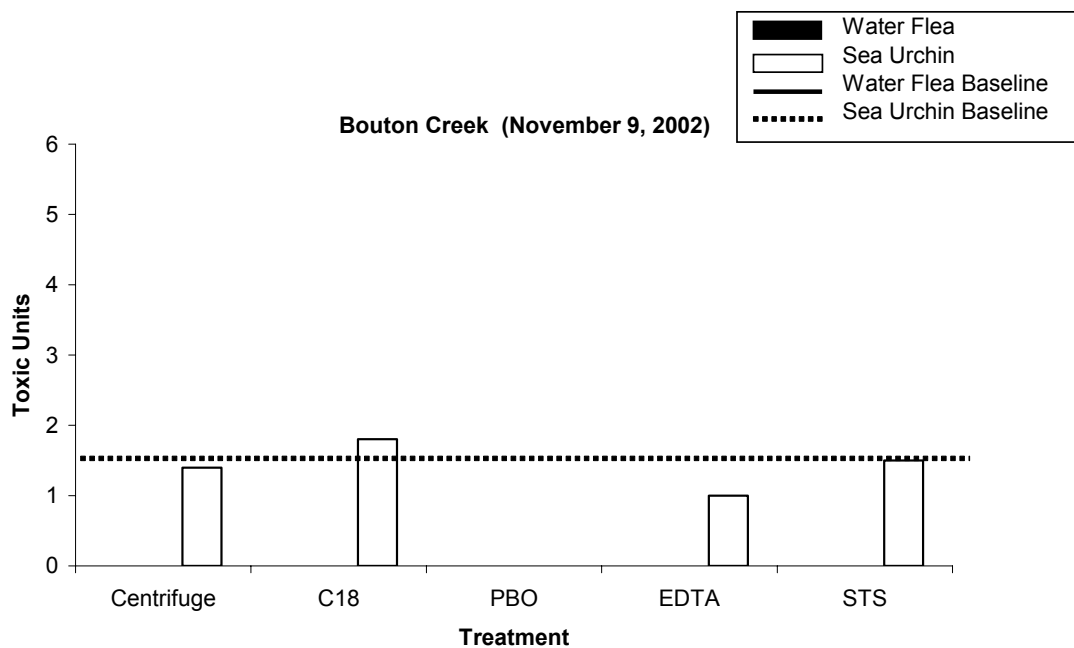
**Figure 7.3. Toxicity Dose Response Plots for Storm Water Samples Collected from Los Cerritos Channel.**



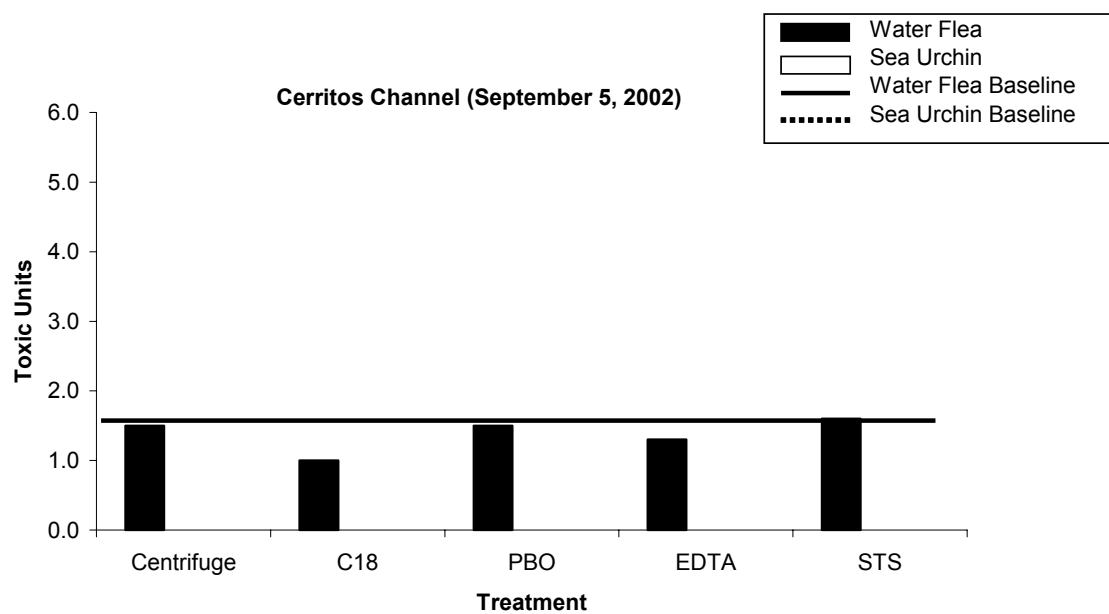
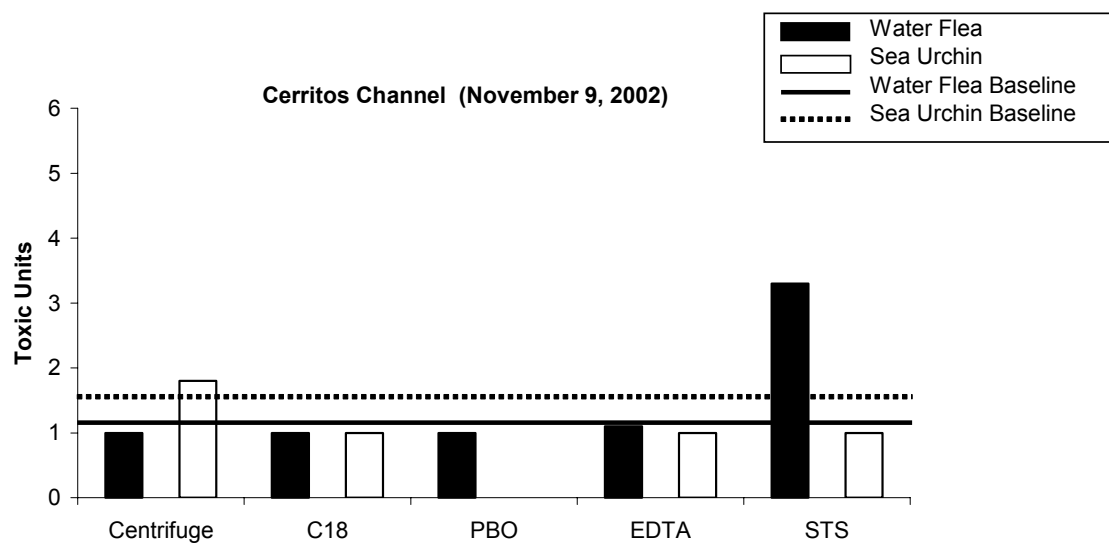
**Figure 7.4. Toxicity Dose Response Plots for Storm Water Samples Collected from Dominguez Gap.**



**Figure 7.5. Summary of Phase I TIE Analyses on Stormwater Samples from the Belmont Pump Station.**



**Figure 7.6. Summary of Phase I TIE Analyses on Stormwater Samples from the Bouton Creek Station.**



**Figure 7.7. Summary of Phase I TIE Analyses on Stormwater Samples from the Los Cerritos Channel Station.**

**Table 7.1. Toxicity of Wet Weather Samples Collected from the City of Long Beach Belmont Pump Station during the 2002/2003 Monitoring Season.** Test results indicating toxicity are shown in bold type. The mysid tests were conducted using 100% sample only.

Date	Test	Test Response (% sample)			TUC <sup>d</sup>
		NOEC <sup>a</sup>	LOEC <sup>b</sup>	Median Response <sup>c</sup>	
11/8/02	Water Flea Survival	25	50	37.5	4
11/8/02	Water Flea Reproduction	25	50	38.7	4
11/8/02	Mysid Survival	≤50	100	na	≥2
11/8/02	Mysid Growth	≤50	100	na	≥2
11/8/02	Sea Urchin Fertilization	12	25	40.5	8
12/17/02	Water Flea Survival	50	100	73.2	2
12/17/02	Water Flea Reproduction	50	100	82.3	2
12/17/02	Sea Urchin Fertilization	>50	>50	>50	>2
2/12/03	Water Flea Survival	100	>100	>100	1
2/12/03	Water Flea Reproduction	100	>100	>100	1
2/12/03	Sea Urchin Fertilization	>50	>50	>50	>2
2/25/03	Water Flea Survival	100	>100	>100	1
2/25/03	Water Flea Reproduction	100	>100	>100	1
2/25/03	Sea Urchin Fertilization	50	>50	>50	2

**Table 7.2. Toxicity of Wet Weather Samples Collected from the City of Long Beach Bouton Creek Station during the 2002/2003 Monitoring Season.** Test results indicating toxicity are shown in bold type. The mysid test was conducted using 100% sample only.

Date	Test	Test Response (% sample)			TUC <sup>d</sup>
		NOEC <sup>a</sup>	LOEC <sup>b</sup>	Median Response <sup>c</sup>	
11/9/02	Water Flea Survival	>100	>100	>100	>1.0
11/9/02	Water Flea Reproduction	>100	>100	>100	>1.0
11/9/02	Mysid Survival	100	100	na	>1.0
11/9/02	Mysid Growth	100	100	na	>1.0
<b>11/9/02</b>	<b>Sea Urchin Fertilization</b>	<b>6</b>	<b>12</b>	<b>32.4</b>	<b>16</b>
12/17/02	Water Flea Survival	100	>100	>100	>1.0
12/17/02	Water Flea Reproduction	100	>100	>100	>1.0
<b>12/17/02</b>	<b>Sea Urchin Fertilization</b>	<b>25</b>	<b>50</b>	<b>&gt;50</b>	<b>4</b>
2/13/03	Water Flea Survival	100	>100	>100	1
<b>2/13/03</b>	<b>Water Flea Reproduction</b>	<b>50</b>	<b>100</b>	<b>&gt;100</b>	<b>2</b>
2/13/03	Sea Urchin Fertilization	>50	>50	>50	>2
2/25/03	Water Flea Survival	100	>100	>100	1
<b>2/25/03</b>	<b>Water Flea Reproduction</b>	<b>50</b>	<b>100</b>	<b>&gt;100</b>	<b>2</b>
<b>2/25/03</b>	<b>Sea Urchin Fertilization</b>	<b>&lt;3</b>	<b>6</b>	<b>&gt;50</b>	<b>33</b>

**Table 7.3. Toxicity of Wet Weather Samples Collected from the City of Long Beach Los Cerritos Channel Station during the 2002/2003 Monitoring Season.** Test results indicating toxicity are shown in bold type. The mysid test was conducted using 100% sample only.

Date	Test	Test Response (% sample)			TUC <sup>d</sup>
		NOEC <sup>a</sup>	LOEC <sup>b</sup>	Median Response <sup>c</sup>	
11/9/02	Water Flea Survival	25	50	37.5	4
11/9/02	Water Flea Reproduction	25	50	41.6	4
11/9/02	Mysid Survival	≤50	≤100	na	≥2
11/9/02	Mysid Growth	≤50	≤100	na	≥2
11/9/02	Sea Urchin Fertilization	6	12	29.5	16
12/16/02	Water Flea Survival	50	100	70.7	2
12/16/02	Water Flea Reproduction	50	100	80.5	2
12/16/02	Sea Urchin Fertilization	6	12	>50	16
2/12/03	Water Flea Survival	100	>100	>100	1
2/12/03	Water Flea Reproduction	50	100	>100	2
2/12/03	Sea Urchin Fertilization	25	50	>50	4
2/25/03	Water Flea Survival	100	>100	>100	1
2/25/03	Water Flea Reproduction	50	100	>100	2
2/25/03	Sea Urchin Fertilization	50	>50	>50	2

**Table 7.4. Toxicity of Wet Weather Samples Collected from the City of Long Beach Dominguez Gap Station during the 2002/2003 Monitoring Season.** Test results indicating toxicity are shown in bold type. The mysid test was conducted using 100% sample only.

Date	Test	Test Response (% sample)			TUC <sup>d</sup>
		NOEC <sup>a</sup>	LOEC <sup>b</sup>	Median Response <sup>c</sup>	
2/12/03	Water Flea Survival	100	>100	>100	1
2/12/03	Water Flea Reproduction	100	>100	>100	1
2/12/03	Sea Urchin Fertilization	>50	>50	>50	>2

**Table 7.5. Summary of TIE Activities.** Acute Toxic Units for the initial (TU-I) and TIE baseline (TU-B) tests are shown (96 hr exposure time for water flea), along with the TIE-related action taken. TIEs were abandoned when the baseline TU value was less than 2.0.

Date	Test	Water Flea			Mysid			Sea Urchin		
		TU-I	TU-B	Action	TU-I	TU-B	Action	TU-I	TU-B	Action
Wet Weather Event:										
11/8/02	Belmont	2.7	1.8	abandon	na	na	na	na	na	na
11/9/02	Bouton	na	na	na	na	na	na	3.1	1.5	abandon
	Los									
11/9/02	Cerritos	2.7	1.1	abandon	na	na	na	3.1	1.5	abandon
Dry Weather Event:										
9/5/02	Belmont	na	na	na	na	na	na	na	na	na
9/5/02	Bouton	na	na	na	na	na	na	na	na	na
	Los									
9/5/02	Cerritos	1.5	1.5	abandon	na	na	na	na	na	na

na = not applicable; insufficient toxicity to trigger TIE

**Table 7.6. Toxicity of Dry Weather Samples from the City of Long Beach.** Test results indicating toxicity are shown in bold type.

Station	Date	Test	Test Response (% sample)			TUC <sup>d</sup>
			NOEC <sup>a</sup>	LOEC <sup>b</sup>	Median Response <sup>c</sup>	
Belmont	9/5/02	Water Flea Survival	100	>100	>100	1
<b>Belmont</b>	<b>9/5/02</b>	<b>Water Flea Reproduction</b>	<b>50</b>	<b>100</b>	<b>&gt;100</b>	<b>2</b>
Belmont	9/5/02	Sea Urchin Fertilization	50	>50	>50	2
Belmont	5/20/03	Water Flea Survival	100	>100	>100	1
Belmont	5/20/03	Water Flea Reproduction	100	>100	>100	1
Belmont	5/20/03	Sea Urchin Fertilization	50	>50	>50	2
<b>Bouton</b>	<b>9/5/02</b>	<b>Water Flea Survival<sup>e</sup></b>	<b>na</b>	<b>na</b>	<b>na</b>	<b>na</b>
<b>Bouton</b>	<b>9/5/02</b>	<b>Water Flea Reproduction<sup>e</sup></b>	<b>na</b>	<b>na</b>	<b>na</b>	<b>na</b>
<b>Bouton.</b>	<b>9/5/02</b>	<b>Sea Urchin Fertilization</b>	<b>12</b>	<b>25</b>	<b>&gt;50</b>	<b>8</b>
<b>Bouton</b>	<b>5/20/03</b>	<b>Water Flea Survival<sup>e</sup></b>	<b>50</b>	<b>100</b>	<b>48.4</b>	<b>2</b>
<b>Bouton</b>	<b>5/20/03</b>	<b>Water Flea Reproduction<sup>e</sup></b>	<b>25</b>	<b>50</b>	<b>33.3</b>	<b>4</b>
<b>Bouton.</b>	<b>5/20/03</b>	<b>Sea Urchin Fertilization</b>	<b>&lt;3</b>	<b>6</b>	<b>18</b>	<b>33</b>
<b>Los Cerritos</b>	<b>9/5/02</b>	<b>Water Flea Survival</b>	<b>50</b>	<b>100</b>	<b>66</b>	<b>2</b>
<b>Los Cerritos</b>	<b>9/5/02</b>	<b>Water Flea Reproduction</b>	<b>25</b>	<b>50</b>	<b>34.1</b>	<b>4</b>
<b>Los Cerritos</b>	<b>9/5/02</b>	<b>Sea Urchin Fertilization</b>	<b>6</b>	<b>12</b>	<b>15</b>	<b>16</b>
<b>Los Cerritos</b>	<b>5/20/03</b>	<b>Water Flea Survival</b>	<b>25</b>	<b>50</b>	<b>45.8</b>	<b>4</b>
<b>Los Cerritos</b>	<b>5/20/03</b>	<b>Water Flea Reproduction</b>	<b>12</b>	<b>25</b>	<b>17.4</b>	<b>8</b>
<b>Los Cerritos</b>	<b>5/20/03</b>	<b>Sea Urchin Fertilization</b>	<b>&lt;3</b>	<b>6</b>	<b>27.1</b>	<b>33</b>

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## **8.0 ALAMITOS BAY PILOT RECEIVING WATER STUDY RESULTS**

### **8.1 Vertical and Horizontal Extent of the Stormwater Plume**

Runoff during the December 16, 2002 storm resulted in a surface plume that extended throughout Alamitos Bay (Figure 8.1). Rainfall measures at the Long Beach mass emission sites ranged from 1.21 to 1.26 inches over a period of roughly four to five hours. In the upper elevations of the Los Angeles Basin, rainfall totaled 3.5 inches over a 24-hour period and was the second highest 24-hour rainfall recorded since records were first maintained in the late 19<sup>th</sup> century.

Based upon the plume characteristics, the Los Cerritos Channel was the major source of stormwater entering Alamitos Bay. The surface salinity increased from essentially fresh levels in the Los Cerritos Channel on a steady, continuous basis around Naples Island to nearly open coast levels at the harbor entrance. Measured surface salinity within Alamitos Bay ranged from 1 to 28 ppt. The lower part of the range was found within the lower reaches of the Los Cerritos Channel near the Pacific Coast Highway Bridge. The higher surface salinities occurred near the Bay entrance. Although salinity was relatively low within the upper reaches of Marine Stadium, the plume from this portion of the watershed was minor in comparison to the plume emanating from the Los Cerritos Channel.

The fresher water of stormwater plume generally formed a surface plume that was typically three to five feet in depth (Figures 8.3a to 8.3h). The layer was thickest and most distinct in Cerritos Creek (Figure 8.3c). The structure of the plume became far less defined near the harbor entrance (Figure 8.3f).

The characteristics of the stormwater plume in western Alamitos Bay differed from those measured elsewhere in the Bay. The stormwater plume in this region tended to be only two to three feet in depth. The plume was most distinct near the Second Street Bridge.

In all cases, the stormwater plume tended to be cooler and more turbid than the underlying marine waters. Temperatures in the plume were typically one degree centigrade lower than the deeper marine waters. Turbidity in the surface plume ranged from 45 to 80 NTU. Marine water under the plume was relatively clear with turbidity measurements typically in the range of 2 to 5 NTU.

### **8.2 Chemical Characterization**

Four sites within the plume were selected on the basis of salinity. The location of these sites is shown in Figure 8.2. After mapping the plume, sampling was initiated at RW1 where salinity within the plume was 24.7 ppt. Three additional sites were sampled with recorded salinities of 16.5 ppt (RW2), 10.9 ppt (RW3) and 8.7 ppt (RW4).

Total suspended solids increased from 10 to 28 mg/L as the surface salinity decreased from 24.7 to 8.7 ppt. Similarly, total copper, nickel, lead and zinc concentrations also increased with decreasing salinity. Concentrations generally doubled over the salinity gradient. Total cadmium was relatively constant with values ranging from 0.09 to 0.12 µg/L.

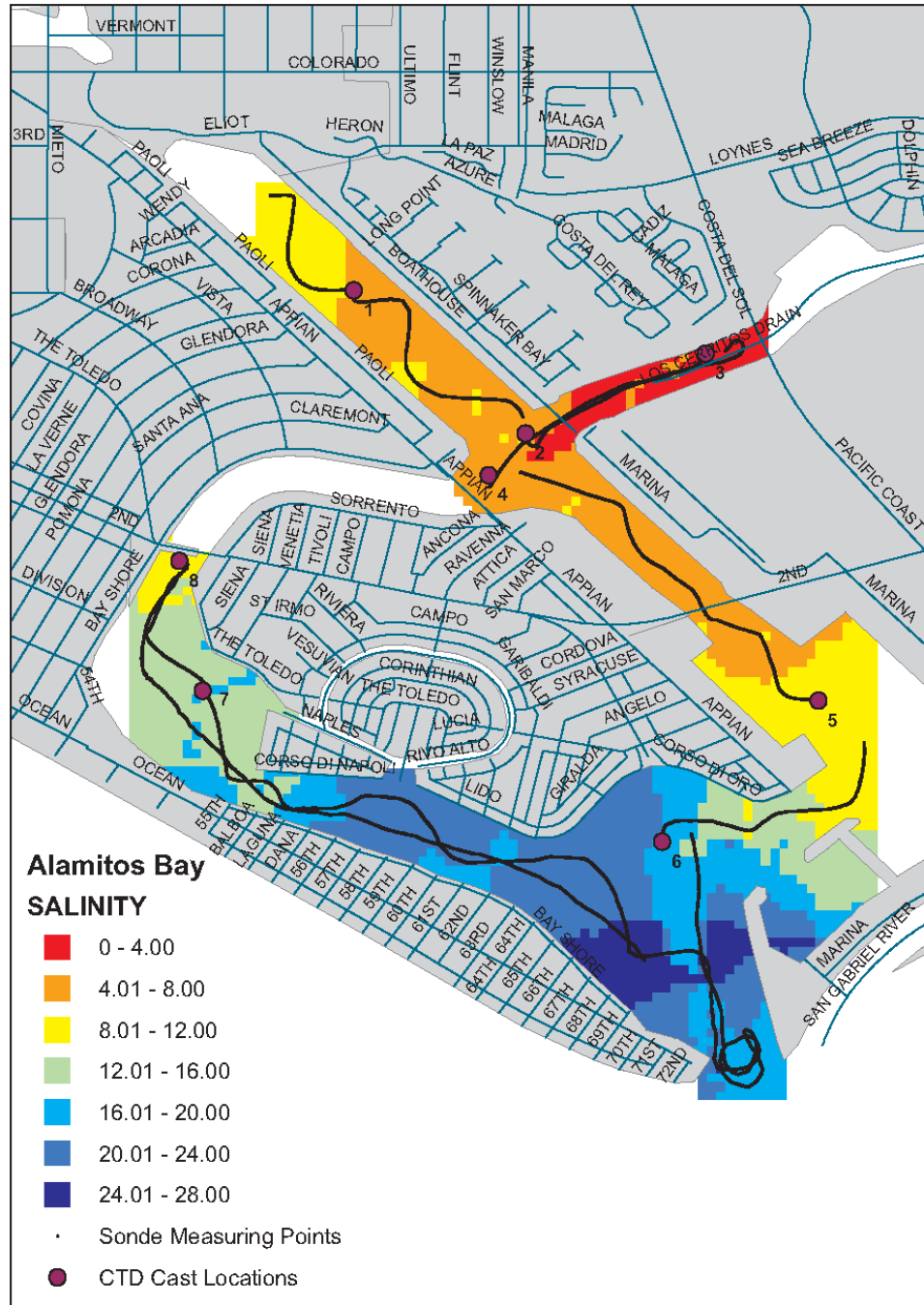
Strong spatial trends were not evident in the distribution of dissolved metals. Concentrations of dissolved cadmium, copper, lead and zinc were all highest at RW1, the station closest to the entrance to the Bay and with the least stormwater influence. The lowest concentrations of dissolved cadmium, copper, lead and

zinc occurred at RW2 where the plume was roughly 50% seawater. Salinity at this site was 16.5 ppt. Overall, however, concentrations of dissolved metals differed by no more than 32 percent at RW2, RW3 and RW4; the three stations with the greatest stormwater influence.

Organophosphate (OP) pesticides were mostly not detected. Simazine, an herbicide, was the only OP pesticide detected in the plume. Concentrations were similar at all locations with levels ranging from 1.1 to 1.3 µg/L.

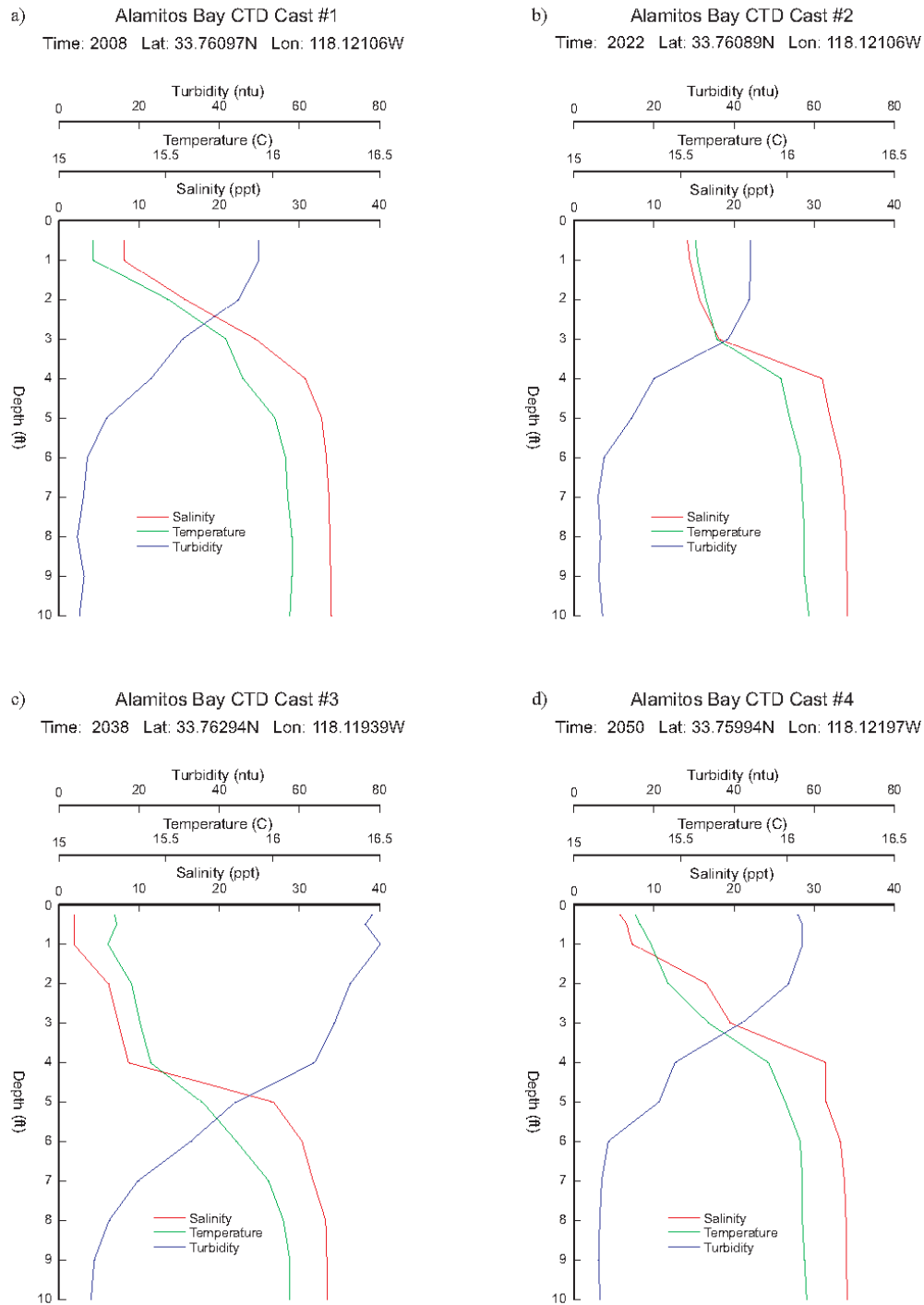
### **8.3 Toxicological Characterization**

Water samples from the four plume sites were tested for toxicity using the sea urchin fertilization test and showed negligible toxicity (Table 8.2, Figure 8.3). Although all EC50s were >50%, the NOECs ranged from 12.5 to 25% in the three sites most influenced by stormwater runoff. Despite the fact the statistical tests indicated significant effects in these three cases, the magnitude of the response was minor (Figure 8.3). The maximum response was observed in tests conducted in water from RW4 where fertilization was 94% of controls in the maximum concentration.



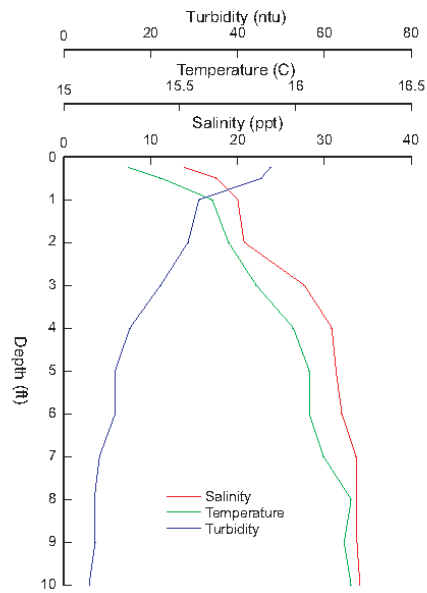
**Figure 8.1** Map of Surface Salinity in Alamitos Bay with Locations of Eight Water Quality Profiling Sites, 12/16/2003.



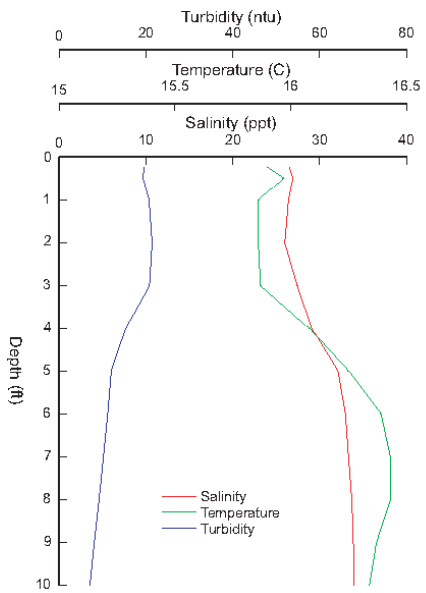


**Figure 8.3(a-d) CTD Casts taken during Alamitos Bay Receiving Water Study**

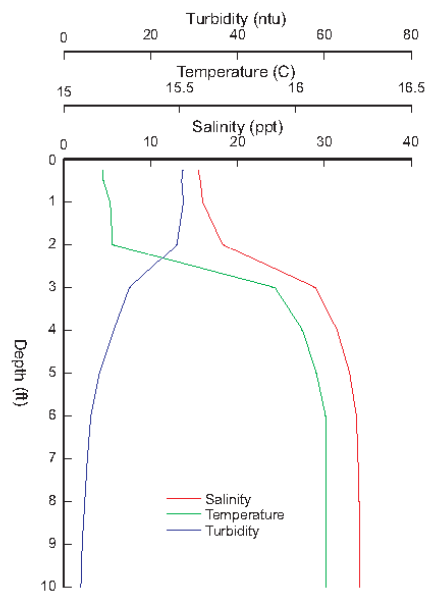
e) Alamitos Bay CTD Cast #5  
Time: 2050 Lat: 33.75439N Lon: 118.11383W



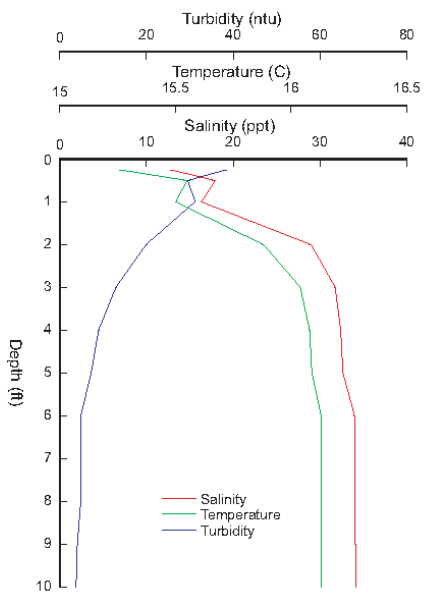
f) Alamitos Bay CTD Cast #6  
Time: 2122 Lat: 33.75092N Lon: 118.11769W



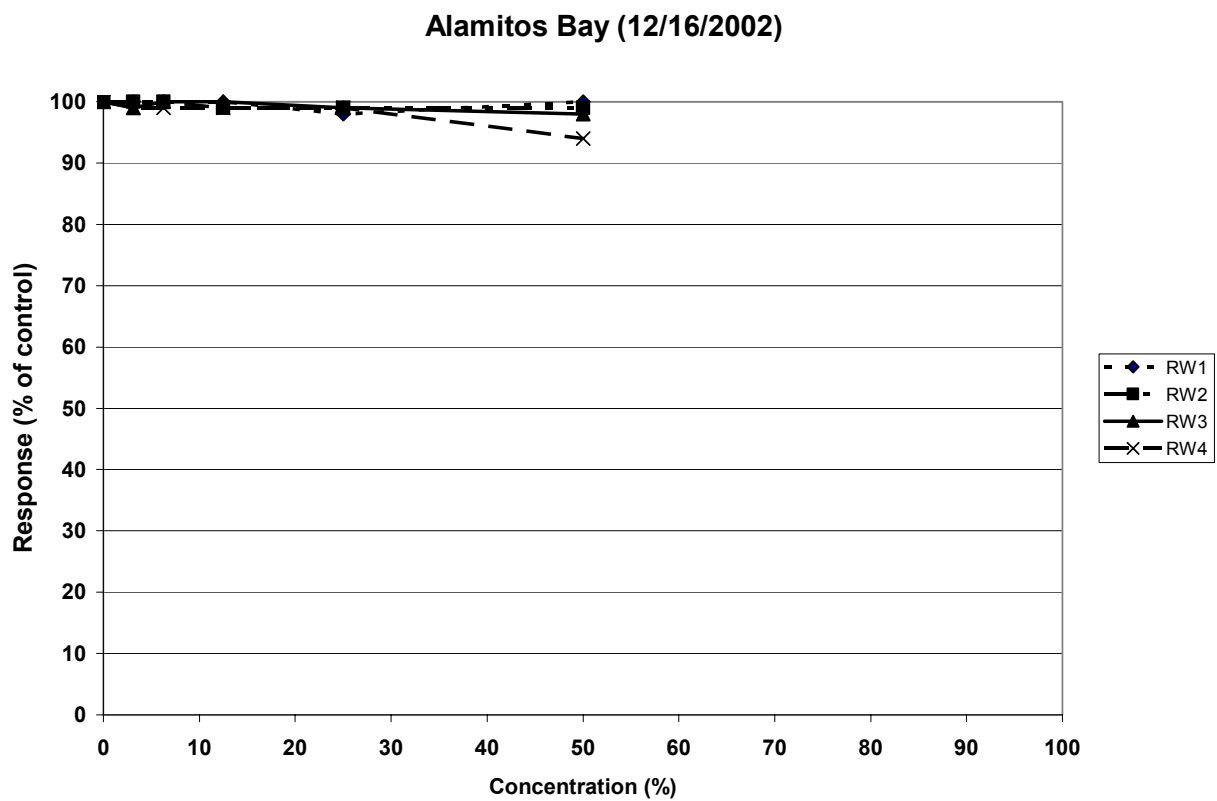
g) Alamitos Bay CTD Cast #7  
Time: 2214 Lat: 33.75464N Lon: 118.12903W



h) Alamitos Bay CTD Cast #8  
Time: 2224 Lat: 33.75783N Lon: 118.12961W



**Figure 8.3(e-h) CTD Casts taken during Alamitos Bay Receiving Water Study.** (Locations of each cast are shown on Figure 8.1)



**Figure 8.4** Toxicity Dose Response Plots for Sea Urchin Fertilization Tests using Stormwater Plume Samples collected from Alamitos Bay.

**Table 8.1 Summary of Receiving Water Quality in Stormwater Plume Samples from Alamitos Bay.**

ANALYTE	Receiving Water Monitoring Sites			
	RW1	RW2	RW3	RW4
<b><i>Conventional</i></b>				
pH	7.8	7.7	7.7	7.7
Specific Conductance (EC – $\mu$ mhos/cm)	35500	24900	17400	14200
Salinity (ppt)	24.7	16.5	10.9	8.7
Total Suspended Solids	10	19	25	28
Ammonia as N (mg/L)	0.24	0.34	0.36	0.34
<b><i>Total Metals (<math>\mu</math>g/L)</i></b>				
Cd	0.09	0.10	0.12	0.11
Cu	4.5	5.6	7.5	7.9
Ni	1.2	1.8	2.5	2.8
Pb	1.7	2.3	3.8	3.5
Zn	17	21	29	38
<b><i>Dissolved Metals (<math>\mu</math>g/L)</i></b>				
Cd	0.06	0.03	0.04	0.04
Cu	2.0	1.1	1.2	1.3
Ni	0.91	1.1	0.94	1.3
Pb	0.74	0.24	0.34	0.40
Zn	12	8.5	9.1	8.7
<b><i>Organophosphate Pesticides (<math>\mu</math>g/L)</i></b>				
Chlorpyrifos (Dursban)	0.05U	0.05U	0.05U	0.05U
Diazinon	0.01U	0.01U	0.01U	0.01U
Atrazine	2U	2U	2U	2U
Cyanazine	2U	2U	2U	2U
Malathion	1U	1U	1U	1U
Prometryn	2U	2U	2U	2U
Simazine	1.1	1.3	1.3	1.2

**Table 8.2 Toxicity of Receiving Water Samples Collected from Alamitos Bay during the 2002/2003 Storm Season.**

Test Species	Endpoint	Receiving Water Monitoring Sites			
		RW1	RW2	RW3	RW4
<i>S. purpuratus</i> - Fertilization	EC <sub>50</sub>	>50%	>50%	>50%	>50%
	NOEC	>50%	12.5%	25%	25%

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## **9.0 DISCUSSION**

### **9.1 Wet Season Water Quality**

Numerical standards are not available for stormwater discharges. Water quality criteria or objectives, however, can provide valuable reference points for assessing the relative importance of various stormwater contaminants. Ultimately, specific beneficial uses of the receiving water body should be considered when selecting the appropriate benchmarks. Existing, potential and intermittent beneficial uses are provided in Table 9.1 for the receiving waters associated with each discharge point.

Tables 9.2 through 9.5 provide a comparison of Event Mean Concentrations (EMCs) for each measured constituent with various water quality criteria. These benchmarks are intended to serve as a tool for interpreting the stormwater quality data and assuring beneficial uses are not impacted. Exceedances of these receiving water quality benchmarks do not necessarily indicate impairment. Other factors such as dilution, duration and transformation in the receiving waters must also be considered.

For comparative purposes, an EMC was considered to be an exceedance if the value was higher than any of the reference values. In using these benchmarks, it is important that the source of the specific criterion is considered. For instance, metals concentrations derived from California Toxics Rule freshwater criteria for protection of aquatic life are based upon dissolved concentrations and are often a function of hardness. Values listed are based upon a default hardness of 50 mg/L. Evaluation of possible exceedances are based upon the hardness EMC for that site and event. Saltwater objectives listed for metals under the CTR are also based upon dissolved concentrations while those listed under the California Ocean Plan are based upon total recoverable measurements. Although Ocean Plan numbers are used for comparative purposes, the marine and estuarine receiving waters in the vicinity of Long Beach would only be subject the CTR saltwater values since Alamitos Bay and the coastal waters of Long Beach are considered enclosed bays and estuaries. Values provided for the Basin Plan are primarily based upon drinking water standards.

#### **9.1.1 Conventional and Bacteria**

Between 50 and 67 percent of the stormwater samples had measured pH values that were below the lower Basin Plan limits of 6.5. In each case pH concentrations were in the range of 6.2 to 6.5. The pH of stormwater is often slightly acidic since rainwater normally tends to be slightly acidic. This is mostly due to dissolved carbon dioxide that the rain “scrubs” from the atmosphere. Other gases such as sulfur dioxide (SO<sub>2</sub>) and nitrogen oxides (NO<sub>x</sub>) can cause further acidification of the rainfall. In Southern California, the National Atmospheric Deposition Program (NADP 2003) indicates that pH associated with rainfall is typically 5.2.

One hundred percent of the samples had TSS concentrations that exceeded the Ocean Plan limit of 3 mg/L. Appropriate benchmarks are not available under the other guideline documents.

As previously noted in this and other stormwater programs, bacteria are commonly found at very high concentrations in stormwater. Total and fecal coliform concentrations exceeded public health criteria under AB411 in 100 percent of the samples. Enterococcus concentrations exceeded AB411 criteria in most, but not all, cases. Enterococcus concentrations measured in runoff from three of the four sites during the event on February 12, 2003 were below AB411 criteria.

### 9.1.2 Trace Metals

Reference values were exceeded at least once for a total of five different total recoverable metals. These included copper, lead, zinc, aluminum, and antimony. Concentrations of total recoverable copper, lead and zinc in runoff from the mass emission sites commonly exceeded Ocean Plan criteria. These criteria were exceeded for all runoff samples from Bouton Creek, the Belmont Pump Station, and the Los Cerritos Channel. Stormwater runoff from the Dominguez Gap Pump Station site had far fewer exceedances with total recoverable zinc and copper criteria being exceeded in only one-third of the events. The Ocean Plan lead criterion of 8 µg/L was exceeded in runoff from all three events at the Dominguez Pump Station.

Two trace metals measured in stormwater were found to exceed primary Maximum Contaminant Level<sup>3</sup> (MCL) for drinking water cited in the Basin Plan. The criterion of 1000 µg/L of total recoverable aluminum was exceeded in all cases. The concentration of antimony exceeded a primary MCL for drinking water on one occasion in runoff from the Los Cerritos Channel.

Dissolved copper, lead and zinc commonly exceeded the reference values. Concentrations of dissolved copper exceeded both the freshwater and saltwater California Toxics Rule (CTR) criteria at all sites during all storm events. Dissolved lead and zinc exceeded the CTR criteria during all storm events at Bouton Creek, the Belmont Pump Station and Los Cerritos Channel. Lead and zinc criteria were exceeded in two out of three events at the Dominguez Gap Pump Station.

### 9.1.3 Chlorinated Pesticides and Organophosphate Pesticides

Very few organic compounds exceeded the reference criteria in runoff from the four mass emission sites. Concentrations of dieldrin exceeded the saltwater CTR criterion in one sample from the Belmont Pump site and another from the Los Cerritos Channel. In both cases, the reported value was less than twice the ML of 0.01 µg/L. Simazine, an organophosphorus herbicide, exceeded the Basin Plan MCL in one sample from the Los Cerritos Channel.

Although the CTR, Basin Plan and Ocean Plans all lack criteria for both diazinon, this pesticide was ubiquitous in the stormwater samples. Another organophosphorous compound of concern, chlorpyrifos, was detected in 25 percent of the stormwater samples from the Belmont Pump Station and Los Cerritos Creek.

## 9.2 Dry Season Water Quality

In previous years, dry season water quality did not vary greatly between sites or sampling dates. In general, the concentrations of suspended particulates and total recoverable metal concentrations are low in dry weather runoff. Trace metals are predominantly in the dissolved form. Hardness is also consistently high which tends to mitigate the effects of the dissolved metals. Concentrations of bacteria are comparable to levels in winter, stormwater runoff. Pesticides and semivolatiles were largely undetected.

Although the previous observations held true at most sites during the past season, sampling conducted at Bouton Creek in May 2003 resulted in elevated levels of TSS, turbidity, total recoverable metals (aluminum, copper, iron, lead, selenium, silver and zinc) and dissolved selenium. For many of these

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<sup>3</sup> The Maximum Contaminant Level (MCL) is a drinking water standard. The MCL is the concentration that is not expected to produce adverse health effects after a lifetime of exposure, based upon toxicity data and risk assessment principles.

constituents, these were among the highest dry weather concentrations encountered at this site since the start of the NPDES monitoring program. The results of this survey suggest that there was an upstream source of soils. The potential source of these sediments has not yet been investigated since the results of the chemical analyses were only recently received and evaluated.

Previous dry weather monitoring within both Bouton Creek and the Los Cerritos Channel have resulted in occasional elevations of pH. The program now calls for immediate upstream investigations to be conducted whenever pH levels are found to exceed 9.0. This year none of the field measurements indicated high pH levels in the receiving water. Despite moderate to high levels of alkalinity (130 to 420 mg/L), laboratory measurements taken within 48 hours of sampling resulted in several cases where pH levels exceeded 9.0.

Sampling and measurement differences may have contributed to some of the differences but the major factor is likely to be the delay associated with measuring pH in the laboratory. Field measurements were taken directly from the water body whereas laboratory measurements were taken in subsamples of the composite water.

### **9.3 Temporal Trends of Selected Metals and Organic Compounds**

Temporal trends were examined for selected trace metals and organic compounds that are often high in storm drain discharges or suspected to be primary sources of toxicity (Figures 9.1 through 9.12). Time series are presented for five trace metals including cadmium, copper, nickel, lead and zinc. Time series are also provided for two important organophosphate pesticides, diazinon and chlorpyrifos, that have been implicated as major sources of toxicity. The figures include all wet and dry weather data for the past three years at each monitoring site. Periods of dry weather are indicated by the shaded areas. Due to the typically large differences between total and dissolved lead concentrations, a separate graphic is included to detail changes in dissolved lead over time.

Although data are not yet sufficient to make definitive statements supported by statistical test, several general trends are emerging. Dissolved concentrations of cadmium, copper, nickel and lead appear to be comparable during both wet and dry weather periods. Unlike these four metals, dissolved zinc concentrations are consistently higher during storm events. Concentrations of total copper, lead and zinc are distinctly higher in association with storm flows. Seasonal differences in total cadmium and nickel are less evident. Similarly, no distinct seasonal trends were noted for either chlorpyrifos or diazinon. In the case of the latter two organophosphate compounds, earlier detection limits were not suitable to provide measurements of these analytes at the levels typically encountered in the discharges.

Characteristics of stormwater discharges from the Dominguez Gap Pump Station also are consistent with earlier observations at this site. Prior to this year, only three storms were sampled at this site. During the 2001/2002 monitoring year rainfall was not sufficient to cause the pumps to be activated at this site. This year another three storm events were monitored. Discharges from this site tend to have lower concentrations of total metals than the other mass emission sites.

Given adequate rainfall in the 2003/2004 monitoring year, hypotheses testing will be conducted to determine if seasonal trends observed for these key contaminants are statistically significant. The seasonal trends in concentrations and partitioning between dissolved and particulate forms will be important in developing control strategies for these constituents.

## **9.4 Stormwater Toxicity**

A total of thirteen wet weather samples were analyzed for toxicity during the monitoring period. All thirteen samples were tested with water fleas and sea urchins (26 total bioassays), and a subset of three of those samples was tested with mysids. There was, then, a total of 29 bioassays performed on thirteen water samples.

Each storm produced similar toxicity results in samples from the Belmont Pump station and the Los Cerritos Channel station, in that the same group of species showed significant toxic effects. Toxicity results were quite different in samples from the Bouton Creek station, with different storms producing toxicity only to sea urchins.

The sea urchin test detected toxicity in six of thirteen storm samples, while the water flea test showed significant toxicity in four of thirteen samples. Mysids showed toxic results in two of three samples tested..

The toxicity of the wet weather samples analyzed during the monitoring period was generally less than that measured during the previous monitoring period (Figure 9.13). One of the Bouton Creek samples contained a high level of toxicity to sea urchins (32 TUC) matching that of Bouton Creek samples tested previously.

### **9.4.1 Dry Weather Toxicity**

The sample of dry weather discharge collected from Belmont Pump station in September 2002 was not toxic to sea urchins, but was toxic to water flea reproduction (but not survival). The magnitude of reproductive toxicity was the same or slightly less than the stormwater samples analyzed during 2002-2003 (Figure 9.13). The Belmont Pump dry weather sample collected in May 2003 produced no toxicity to either water fleas or sea urchins.

The dry weather samples collected from Bouton Creek were both characterized by elevated salinity. The water flea test was not performed on the September 2002 sample. The slightly less saline sample collected in May 2003 was tested, however, and showed both lethal and reproductive toxicity. Some portion of this toxicity may have been due to salinity stress on this freshwater test organism. Both the September 2002 and May 2003 dry weather samples from Bouton Creek were toxic to sea urchins, with TUC values of 8 and 32, respectively. The magnitude of the toxicity to sea urchins was comparable to that seen in three of the four storm samples tested in the 2002-2003 monitoring period.

Both dry weather samples from the Los Cerritos Channel were toxic to both test species. The September 2002 dry weather sample produced 2-4 TUC of toxicity to water fleas and 16 TUC of toxicity to sea urchins. The May 2003 dry weather sample showed about twice as much toxicity to each species, producing 4-8 TUC to water fleas and 32 TUC to sea urchins. The magnitude of dry weather toxicity in September 2002 was comparable to that seen in wet weather samples analyzed during 2002-2003, but toxicity in the May 2003 dry weather samples was greater than that seen in wet weather samples.

Data from the previous (2001-2002) monitoring period suggested that dry weather samples collected in May 2002 were generally less toxic than wet weather samples collected during the winter of 2001-2002, and that this pattern was consistent with dry weather results from the 2000-2001 monitoring period. These toxicity results were cited to support the indication that “there are significant differences in the

composition of stormwater and dry weather discharge from the City of Long Beach” (Kinnetic Laboratories Inc. and Southern California Coastal Water Research Project July 2002)

Data from the 2002/2003 monitoring period indicate that the magnitude of dry weather toxicity was somewhat less than wet weather toxicity at the Belmont Pump station. At the Bouton Creek station, dry weather and wet weather toxicities were of similar magnitude, while at the Los Cerritos Channel station dry weather discharge showed equal or greater toxicity to stormwater, with particularly elevated toxicity to sea urchins in the May 2003 collection. Current toxicity data, then, do not necessarily support the indication of significantly different composition of seasonal discharges.

#### **9.4.2 Temporal Toxicity Patterns**

The toxicity data from the 2000/2001 and 2001/2002 monitoring periods suggest that seasonal flushing may be an important factor affecting the variability in stormwater toxicity, and current data from the 2002/2003 monitoring period generally support that suggestion.

At the Belmont Pump station significant toxicity was seen in all three species during the first storm event (4 TUC and 8 TUC to water fleas and sea urchins, respectively). The second storm produced reduced toxicity (2 TUC) to water fleas only, and storms three and four showed no measurable toxicity to any species.

Bouton Creek samples showed toxicity only to sea urchins. The first storm produced 16 TUC, the second storm produced 4 TUC and the third storm produced no urchin toxicity. The fourth storm, however, produced the highest toxicity (32 TUC) of any wet weather samples tested during this period.

Cerritos Channel samples produced toxicity to all three species in the first storm, with 4 TUC to water fleas and 16 TUC to sea urchins. The second storm produced no toxicity to urchins and only 2 TUC to water fleas. The third storm showed no water flea toxicity and 4 TUC to urchins, and the fourth storm produced no toxicity to either species.

With the obvious exception of storm four at Bouton Creek, there is a clear trend toward decreasing toxicity with increased flushing.

In previous studies, it was found that early season storm water runoff from Ballona Creek (Los Angeles County) was more toxic than samples obtained later in the season (Bay *et al.* 1999).

#### **9.4.3 Comparative Sensitivity of Test Species**

There were a total of twelve wet weather samples tested for toxicity with both water fleas and sea urchins. Toxicity was detected to one or both species in eight of those samples and the sea urchin fertilization test was the most sensitive toxicity test method in six of those eight samples. The water flea survival/reproduction test was the most sensitive method for the December 16 sample from Los Cerritos Channel and the December 17 sample from the Belmont Pump station. Neither of those stormwater samples was toxic to sea urchins. In addition there were six dry weather discharge samples tested using water fleas and sea urchins. Of those six samples, five showed toxicity and the sea urchin was the more sensitive test in four of those five. Thus, of the thirteen water samples showing toxicity, the sea urchin test was the more sensitive in 10 samples (77%).

The relative sensitivity of the mysid toxicity test could not be evaluated for this monitoring period because only the 100% stormwater concentration was tested, which prevented estimation of a precise

value for the EC50 or NOEC. Mysid survival and growth in 100% stormwater generally indicated less toxicity than the sea urchin or water flea results for similar sample concentrations, indicating that the mysid test was the least sensitive of the three methods.

This same pattern of sensitivity (sea urchin > water flea > mysid) was also observed during the 2000/2001 monitoring program and in a study of urban stormwater toxicity in San Diego (Southern California Coastal Water Research Project 1999).

#### **9.4.4 Relative Toxicity of Stormwater**

Table 9.6 compares the frequency and magnitude of stormwater toxicity from the Long Beach stations in 2002/2003 with that of stormwater samples from Long Beach in previous years and with toxicity in other southern California watersheds. The data suggest a marked decrease from previous years in the frequency of Long Beach stormwater toxicity during the 2002/2003 monitoring year and also show a decreased magnitude of toxicity to water fleas. Both frequency and magnitude are also decreased from those reported for other nearby watersheds.

Results from the Chollas Creek and Ballona Creek studies would be expected to be similar to the Long Beach study, as these samples were obtained from smaller highly urbanized watersheds, relative to the samples from the L.A. River and San Gabriel River. The data suggest such comparability for Long Beach samples from the first two monitoring periods, but clearly indicate the changes seen during the 2002/2003 monitoring period. Toxicity in Long Beach samples and in those from other watersheds is variable among storms, and stormwater toxicity is most often detected using the sea urchin fertilization test.

#### **9.4.5 Toxicity Characterization**

The TIE testing program for this monitoring period was limited due to overall low levels of toxicity in the stormwater samples during the past year. Phase I TIEs were attempted on four wet weather and one dry weather samples and they yielded useful information for all five samples. In addition, two more samples on which limited TIEs were run concurrently with initial toxicity testing of the samples yielded useful information for sea urchins. The remaining TIE was not useful due to the substantial loss of toxicity with time in the laboratory.

The results of the 2002/2003 TIE analyses were consistent within each species and generally similar to the data obtained from the previous year (Table 9.7). One of the TIEs conducted using the water flea indicated that organophosphate (OP) pesticides was the most likely category of toxic constituents. This conclusion is supported by the effectiveness of the C-18 and PBO treatments for reducing toxicity to the water flea. Other monitoring programs in California have obtained similar Phase I TIE results and subsequent studies have verified that OP pesticides are frequently the cause of urban stormwater toxicity to this species. In the other water flea TIE, an uncategorized non-polar organic (NPO) toxicant was implicated because the C18 treatment was effective and the PBO treatment was not effective.

EDTA was consistently the most effective treatment for removing toxicity in the sea urchin TIEs. EDTA is effective at chelating divalent metals, such as copper, cadmium and zinc, thus rendering them biologically unavailable. Studies in other watersheds have also found EDTA to be successful at removing toxicity from runoff (Jirik *et al.* 1998, Schiff *et al.* 2001). In these studies, copper and zinc were found to be the specific metals most likely causing toxicity. Solid phase extraction using C-18 was partially effective at removing toxicity to sea urchins from the Los Cerritos Channel sample. This treatment is intended to remove non-polar organic contaminants from the sample. However, C-18 treatment has also been shown to remove significant amounts of toxicity associated with copper and zinc from the water

(Schiff *et al.* 2001). Toxicity in the Los Cerritos Channel sample was also reduced by treatment with STS, which can reduce toxicity to some metals (e.g., cadmium, copper, zinc). Since solid phase extraction, STS and EDTA were all highly effective in this sample, it is likely that divalent metals, rather than organics, caused the observed toxicity. The other possibility is that both metals and non-polar organics are present and acting in a synergistic manner so that the removal of one effectively eliminates most of the toxicity in the sample. Additional tests are necessary to confirm the unlikely presence of such a synergistic effect.

The removal of particles by centrifugation was not effective in reducing toxicity in any sample. Previous studies have also found particle removal to be an ineffective method for the removal of toxicity from stormwater (Bay *et al.* 1999). However, particles may contribute to the chemical-associated toxicity of stormwater from the desorption of bound contaminants into the water. A previous study found that urban stormwater particles released toxic quantities of unidentified materials into clean seawater in less than 24 hours (Noblet *et al.* 2001).

Correlation analysis of the toxicity and chemistry data provides an additional test of the association between stormwater toxicity and chemical contamination. The data from all three years of monitoring were pooled for the correlation analyses, except for the test using diazinon, which was detected only in the second and third years of monitoring. The correlation analyses confirm the results from the first year of study: that the toxic responses measured in this study are related to the chemical composition of the stormwater samples. The toxic responses of sea urchins and/or water fleas were significantly correlated with increased concentrations of several stormwater constituents, including dissolved metals, TSS, TDS and TOC (Table 9.8). Dissolved lead, nickel and zinc were significantly correlated with toxicity to both species. As in last years report, zinc showed the strongest correlation with reduced sea urchin fertilization, closely followed by copper. Lead and nickel were also significantly correlated with sea urchin fertilization. These results differed from those obtained using only the first two years of monitoring data, which showed significant correlations only with dissolved copper and zinc.

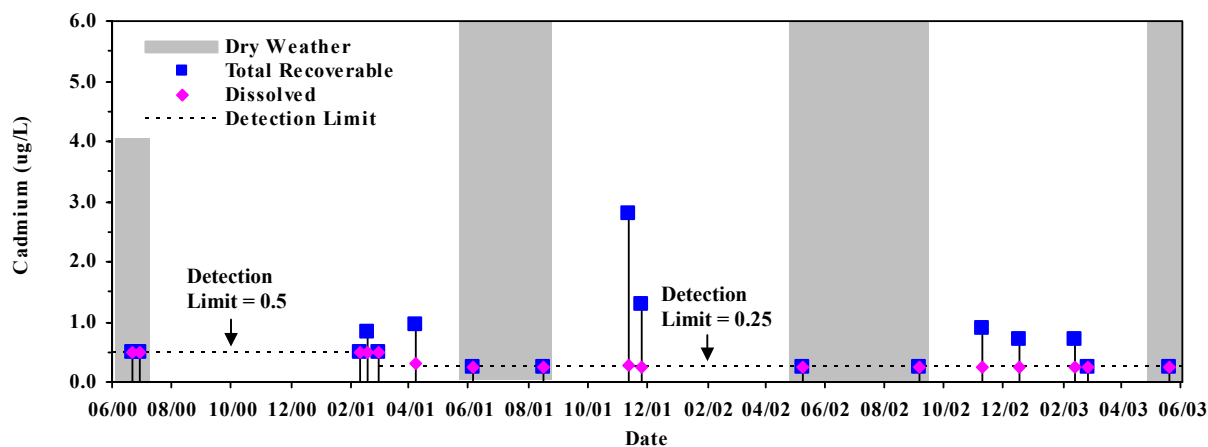
A larger number of constituents were significantly correlated with toxicity to the water flea, including TSS, TOC, and dissolved metals including lead, nickel and zinc (Table 9.8). Increased concentrations of the OP pesticide diazinon had correlations with water flea toxicity ( $r=0.22$  to  $0.24$ ) that were reduced from the values reported in 2001/2002 ( $r=0.54$ ). The association was clearly not statistically significant, perhaps due to the small number of data points available and/or the high frequency of samples in which diazinon was not detected.

The presence of significant correlations between toxicity and selected chemicals generally supports the TIE results and provides information to help identify key constituents of concern, but the statistical results do not prove that those constituents are the cause of toxicity. The true cause of toxicity may be another (possibly unmeasured) constituent that has a similar pattern of occurrence in the samples.

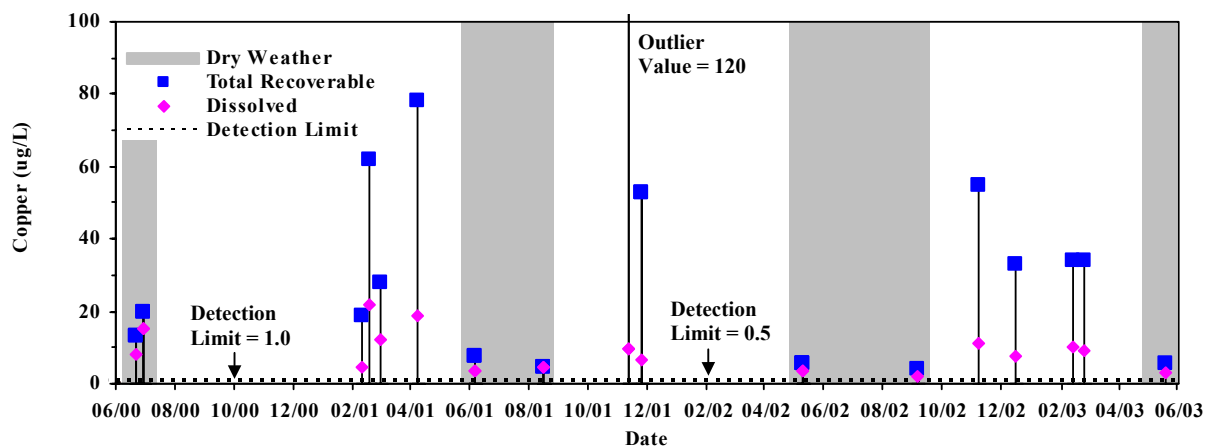
A third method, comparing the measured and predicted toxic units of the samples was used to assess the importance of zinc, copper, and pesticides as a cause of the toxicity of Long Beach stormwater. The predicted toxicity of the sample was calculated from the measured concentrations of the chemical constituents and their corresponding EC50 or LC50. This toxic unit comparison showed that all three stormwater samples that produced toxicity to sea urchins contained sufficient dissolved zinc and copper to account for all of the sea urchin toxicity measured (Figure 9.14). Note that the predicted toxicity of the toxic samples was markedly higher than that of the remaining stormwater samples. These results were similar to those obtained for the monitoring data from the first two years.

Comparison of the measured and predicted toxic units for the water flea tests (Figure 9.15) showed a different pattern from that obtained for the sea urchin tests. The toxicity of two of the four samples

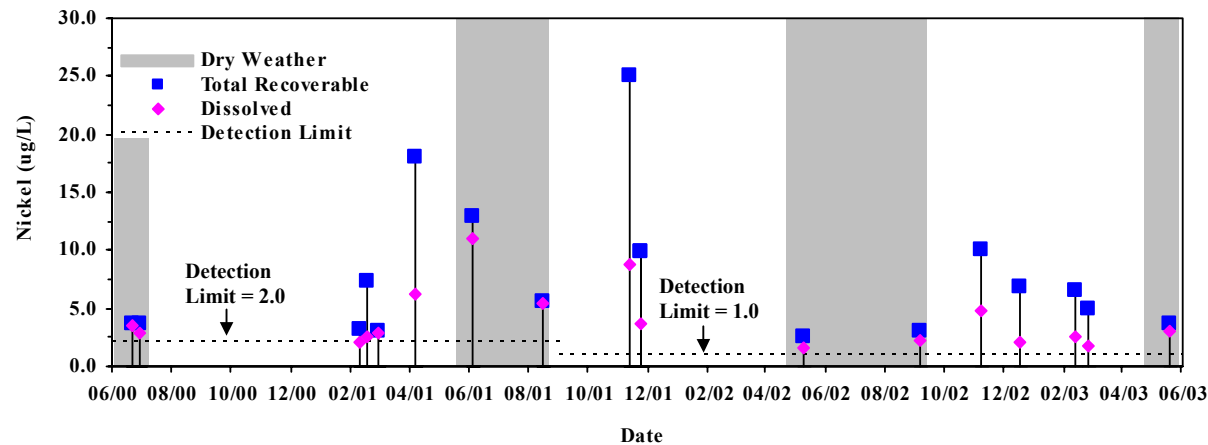
containing substantial toxicity could be accounted for by the measured concentrations of diazinon and chlorpyrifos. While zinc was estimated to contribute  $\leq 1$  toxic unit, the addition of zinc toxicity to the predicted pesticide toxic units for the second storm sample from Los Cerritos could account for all of the measured toxicity. The measured concentrations of OP pesticides and zinc accounted for only about 70% of the toxicity of the first Belmont Pump Station sample, suggesting that additional unmeasured toxicants are present. Alternatively, the undetected poor recovery of chemical analytes or losses during storage may have reduced the measured concentrations of some constituents and resulted in low predicted toxicity values.



a)

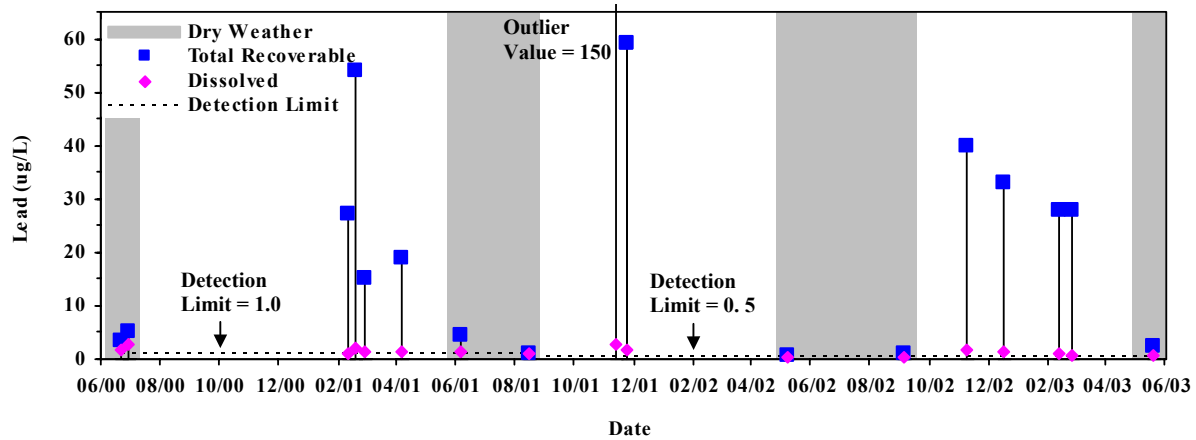


b)

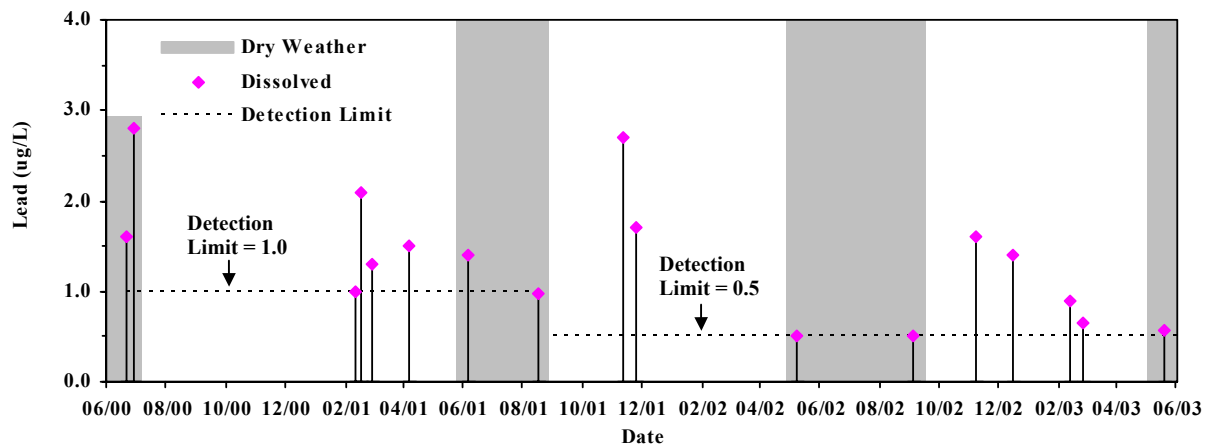


c)

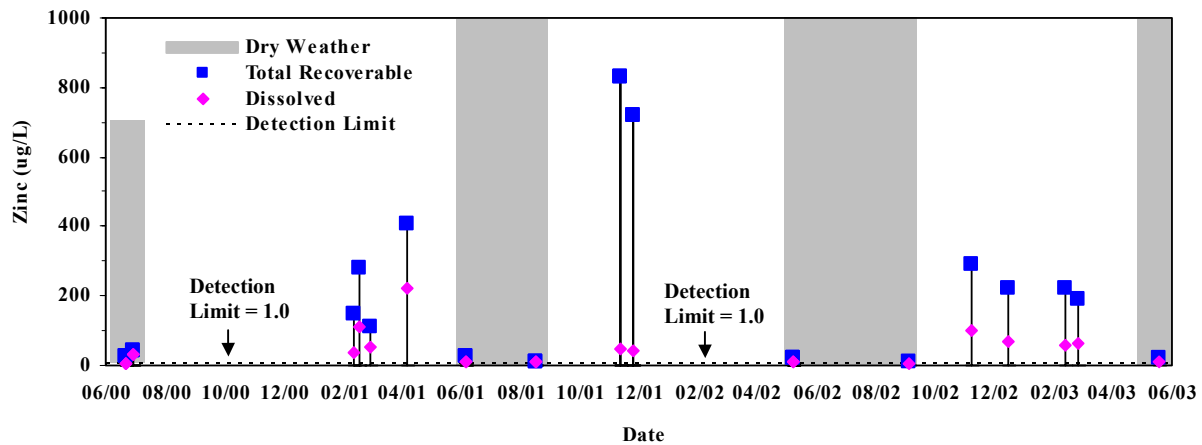
**Figure 9.1 Belmont Pump Station Chemistry Results: a) Cadmium; b) Copper; c) Nickel.**



a)

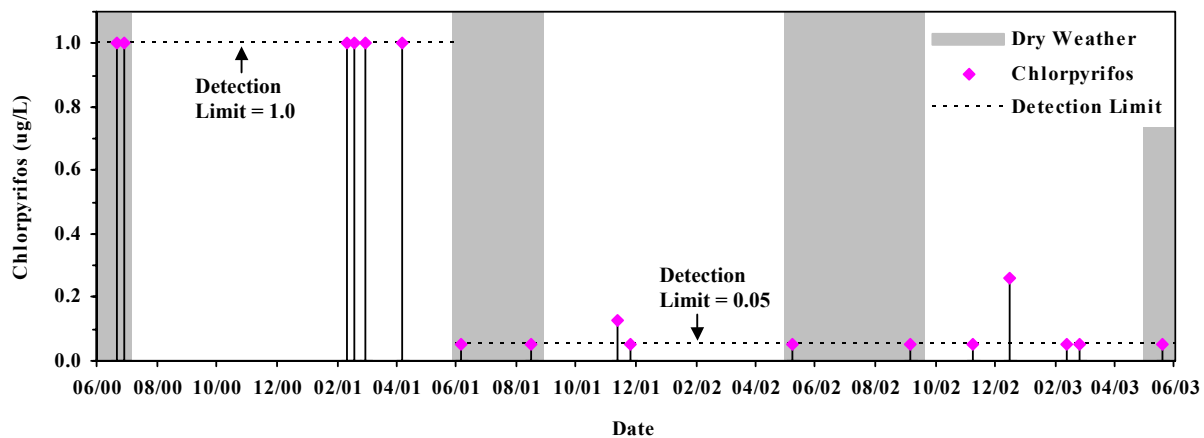


b)

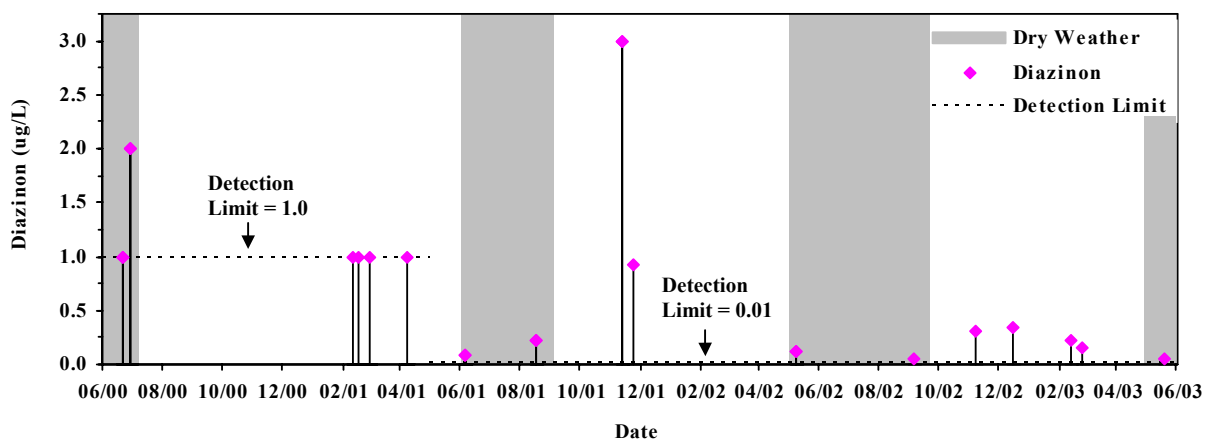


c)

**Figure 9.2 Belmont Pump Station Chemistry Results: a) Lead (total and dissolved); b) Lead (dissolved); c) Zinc.**

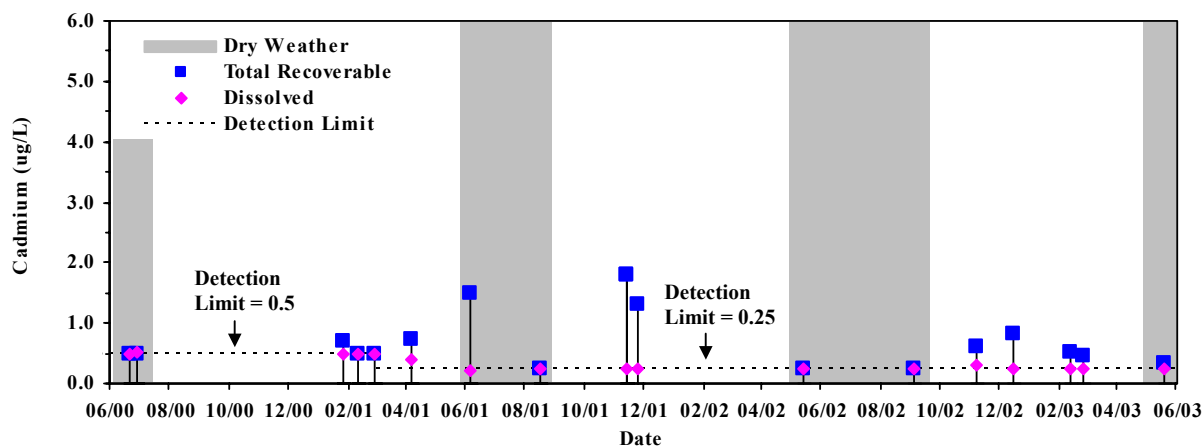


a)

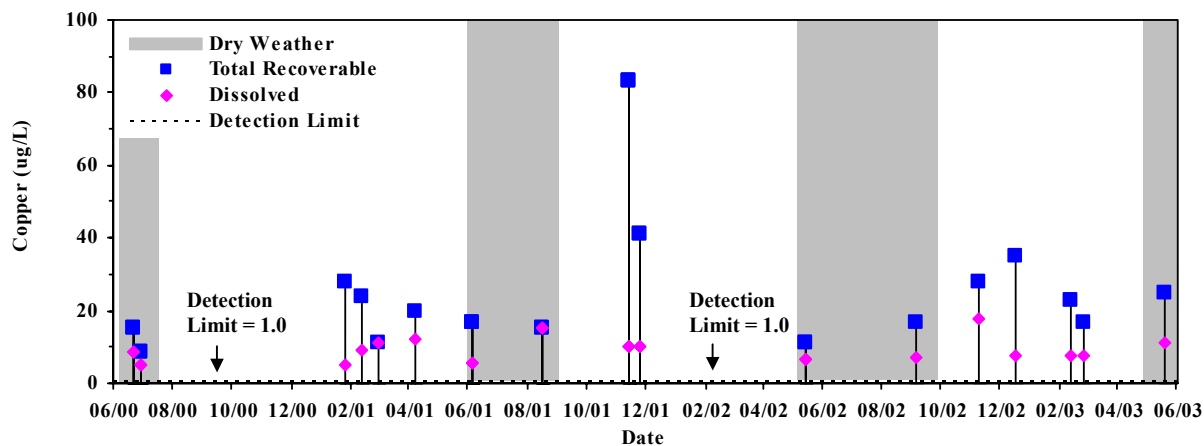


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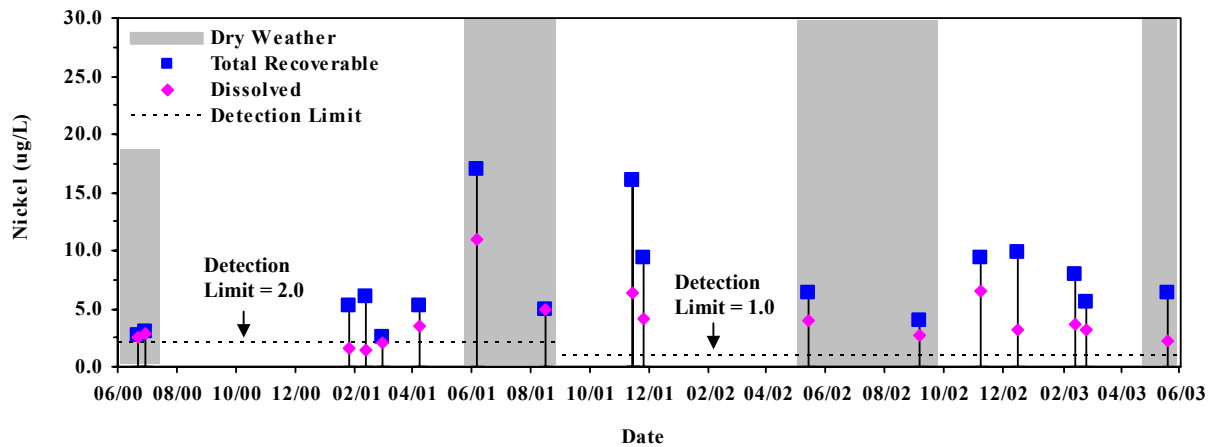
**Figure 9.3 Belmont Pump Station Chemistry Results: a) Chlorpyrifos; b) Diazinon.**



a)

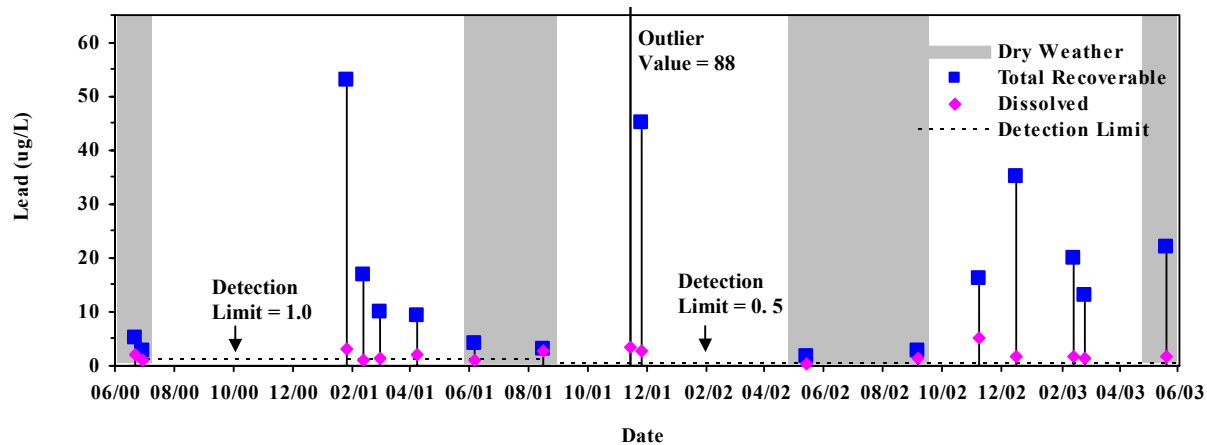


b)

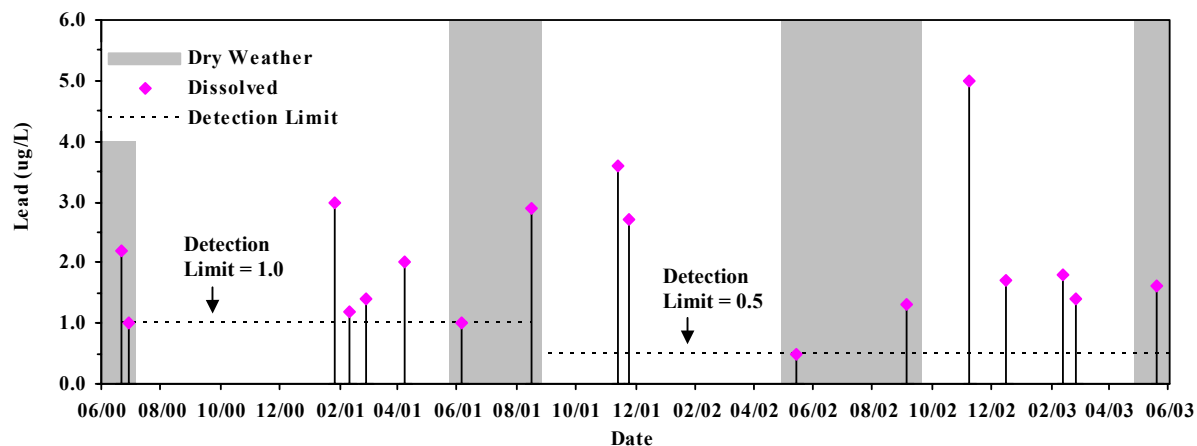


c)

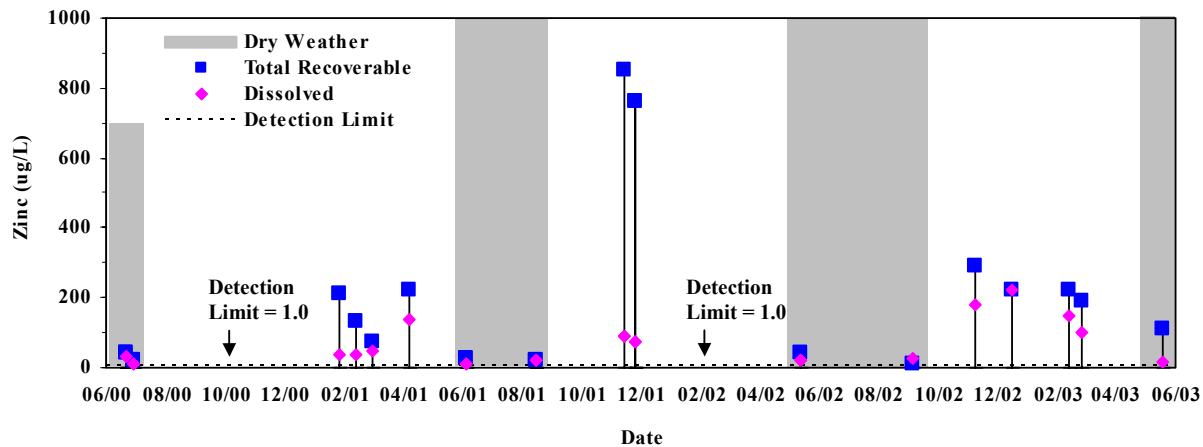
**Figure 9.4 Bouton Creek Chemistry Results: a) Cadmium; b) Copper; c) Nickel.**



a)

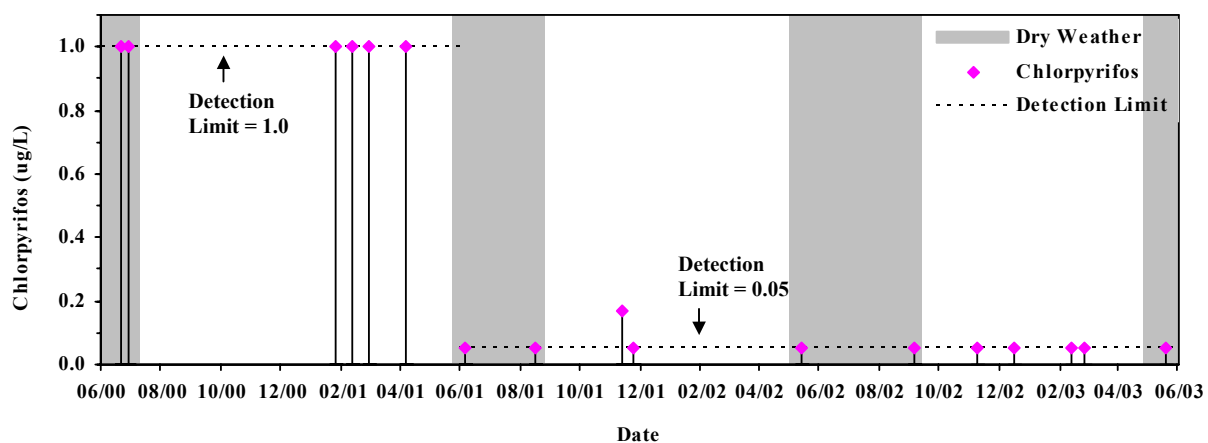


b)

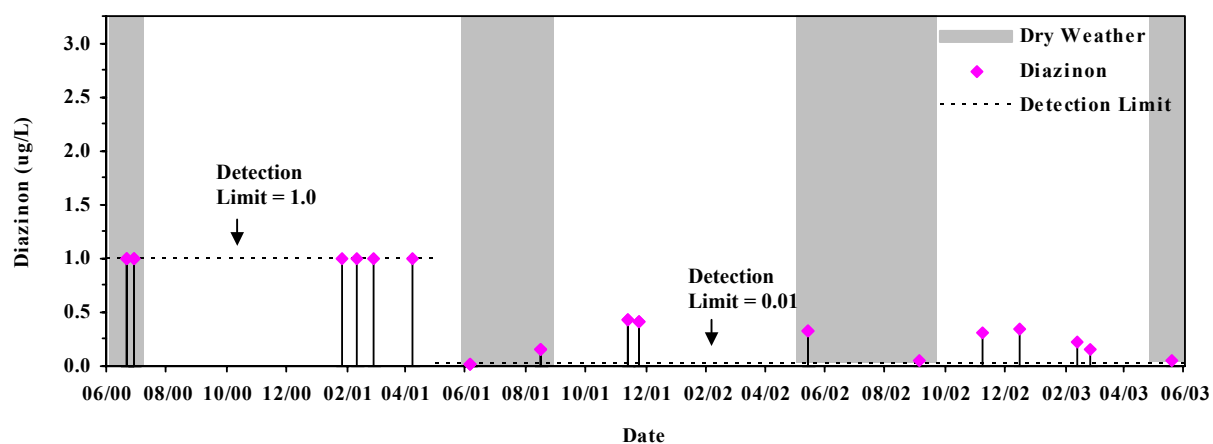


c)

**Figure 9.5 Bouton Creek Chemistry Results: a) Lead (total and dissolved); b) Lead (dissolved); c) Zinc.**

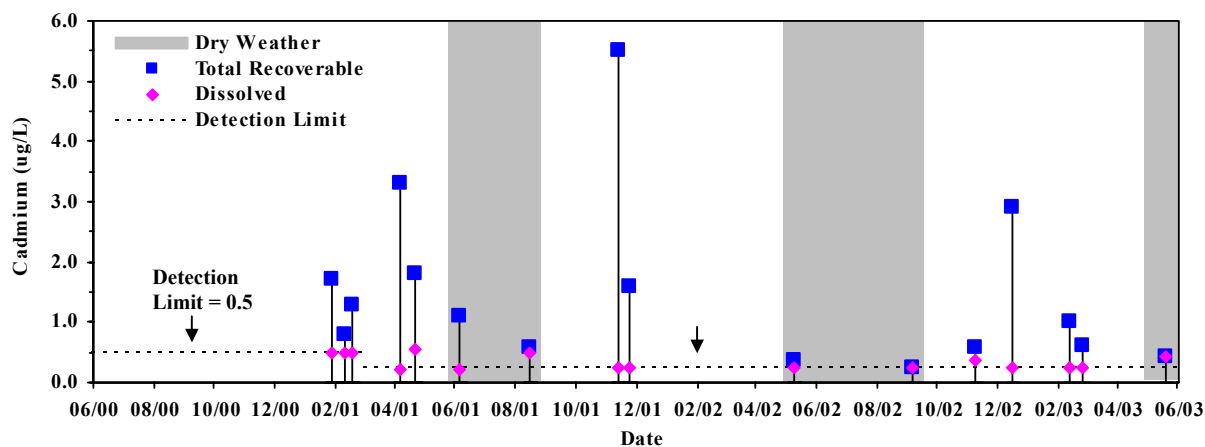


a)

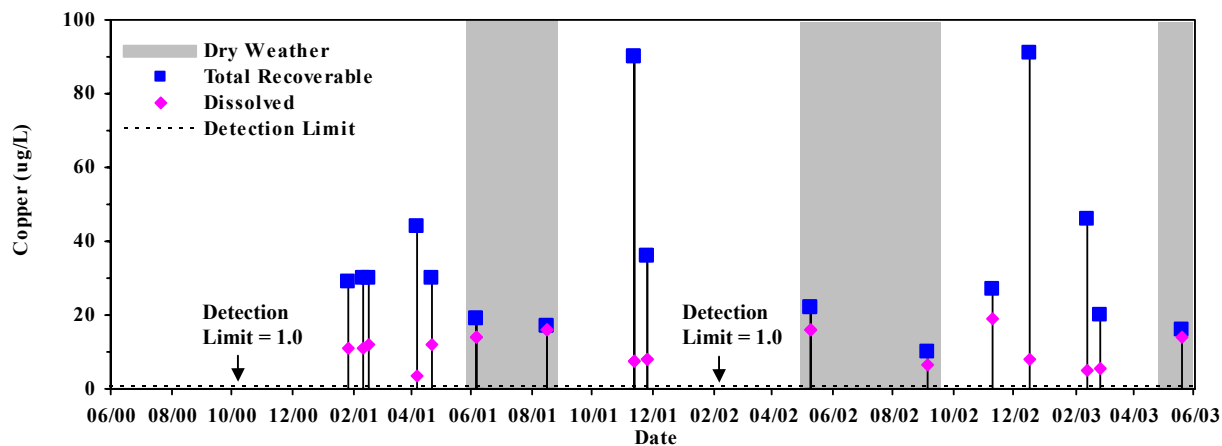


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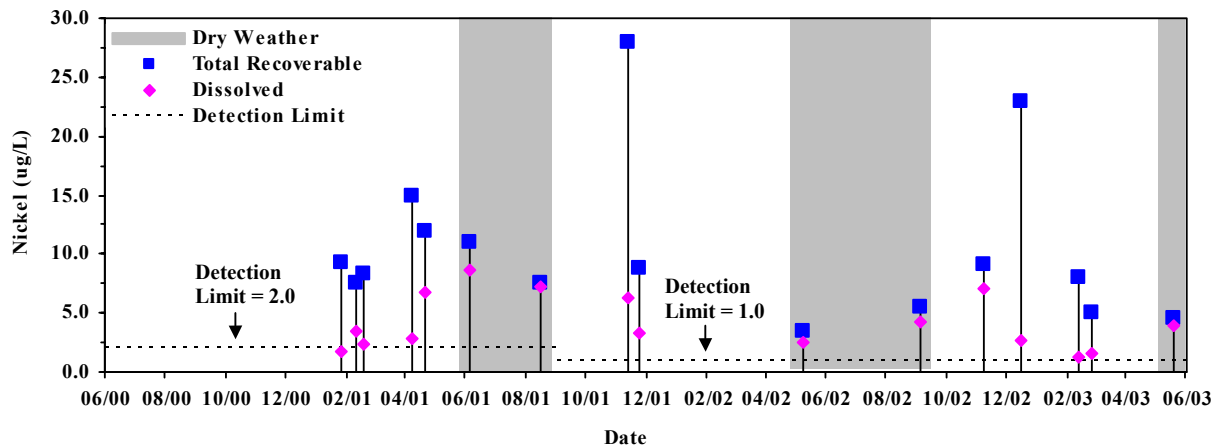
**Figure 9.6 Bouton Creek Chemistry Results: a) Chlorpyrifos; b) Diazinon.**



a)

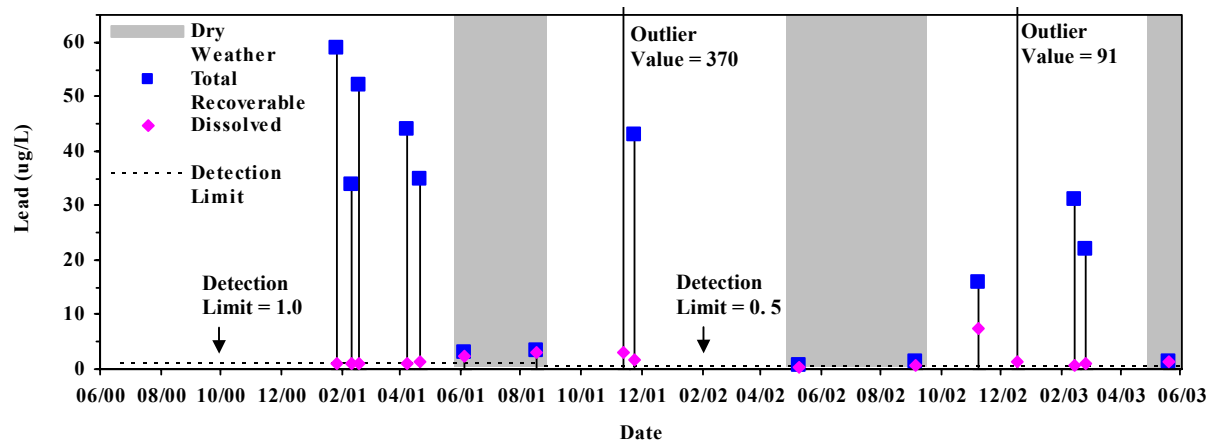


b)

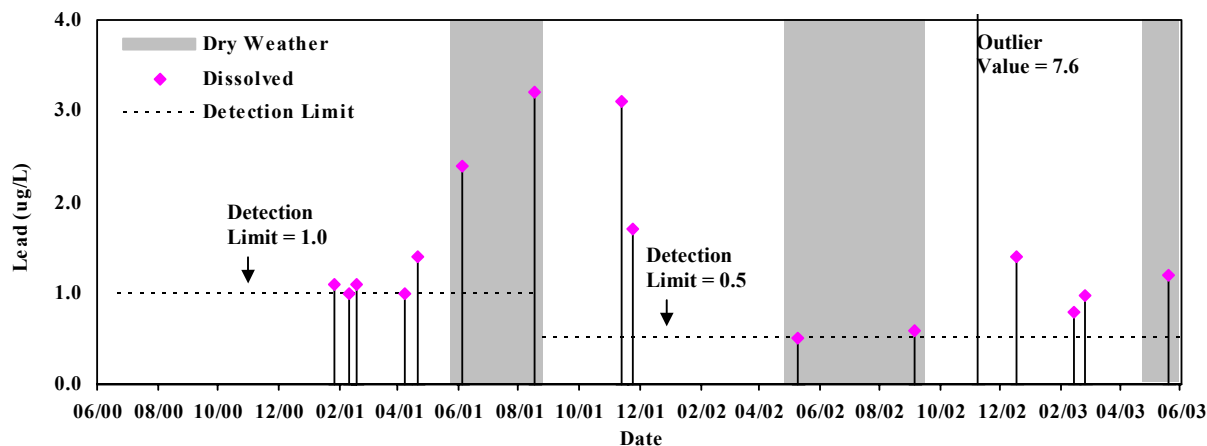


c)

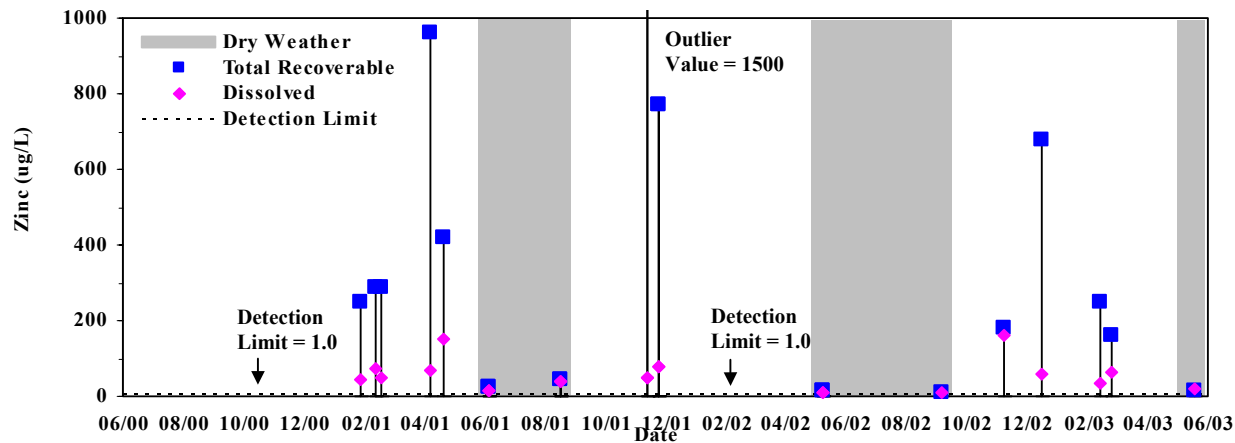
**Figure 9.7 Los Cerritos Channel Chemistry Results: a) Cadmium; b) Copper; c) Nickel.**



a)

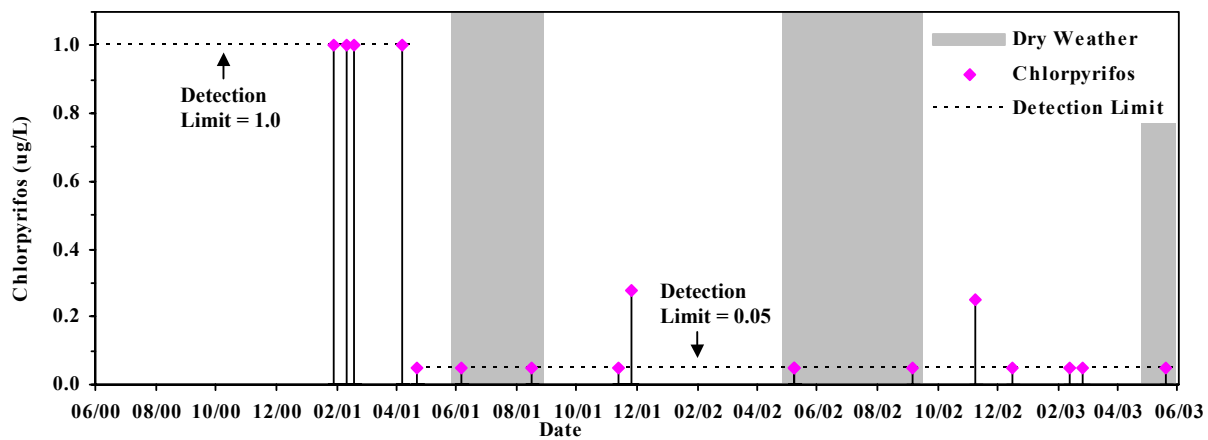


b)

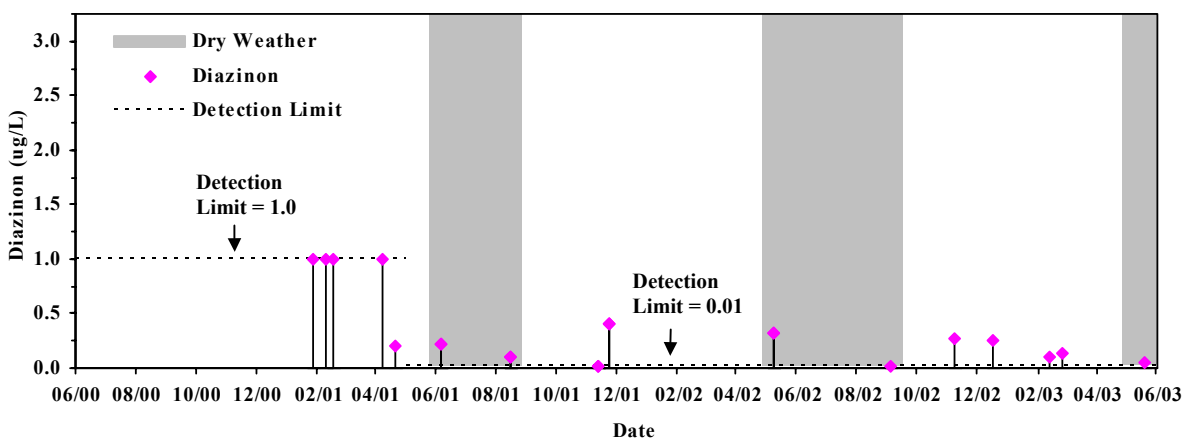


c)

**Figure 9.8** Los Cerritos Channel Chemistry Results: a) Lead (total and dissolved); b) Lead (dissolved); c) Zinc.

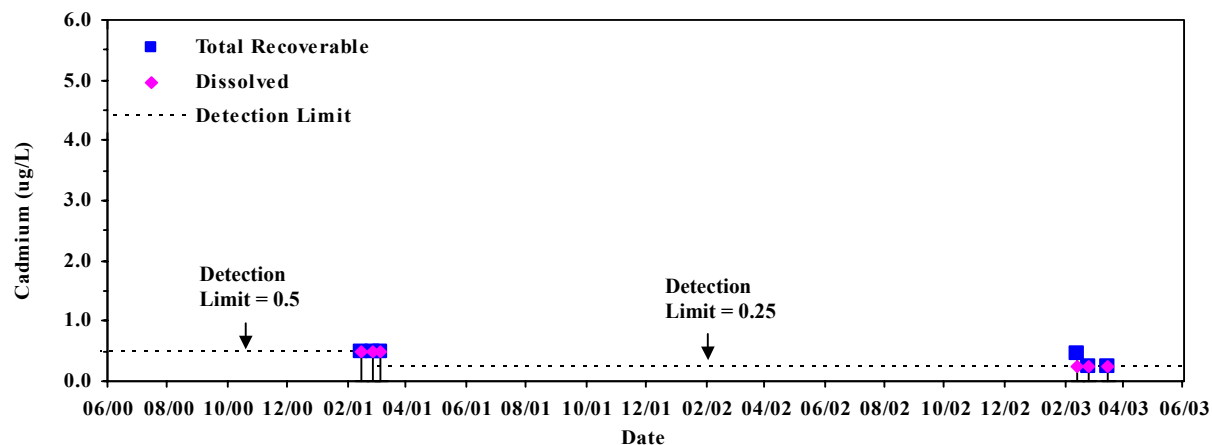


a)

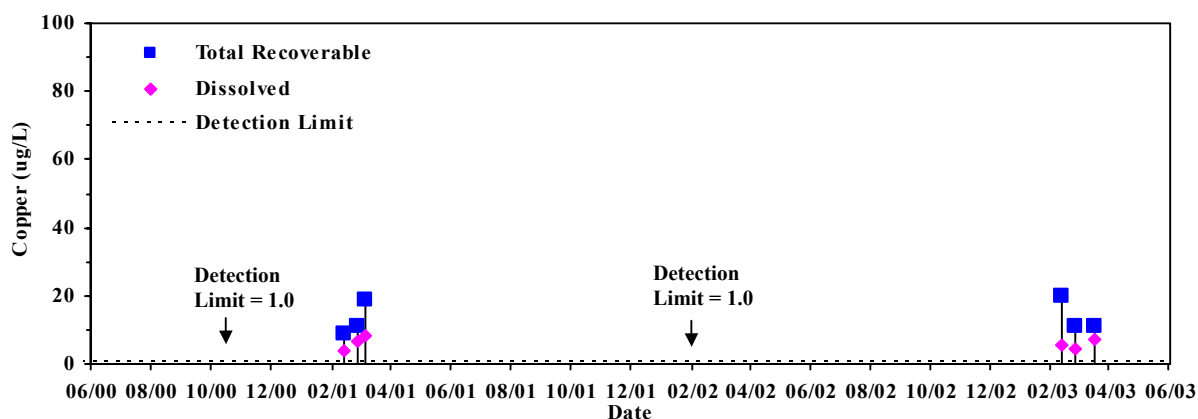


b)

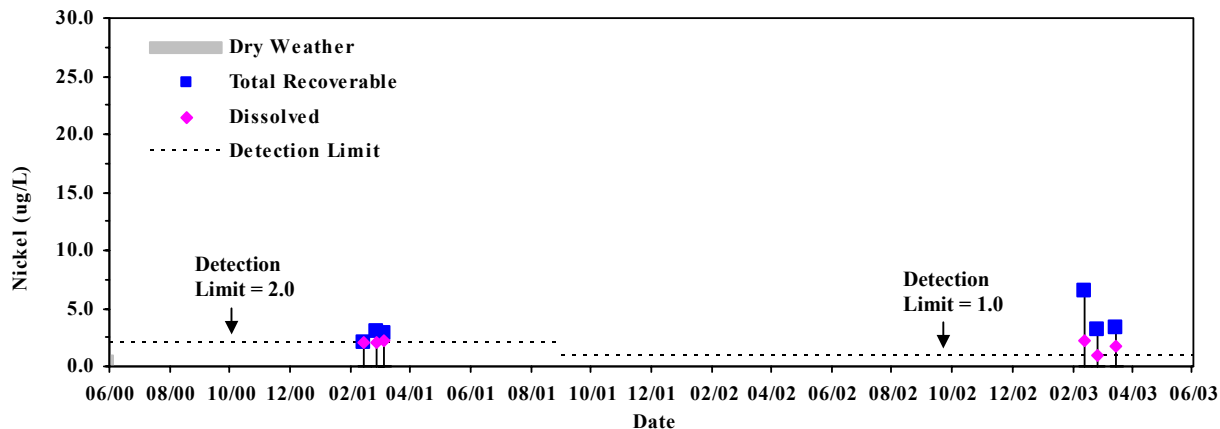
**Figure 9.9 Los Cerritos Channel Chemistry Results: a) Chlorpyrifos; b) Diazinon.**



a)

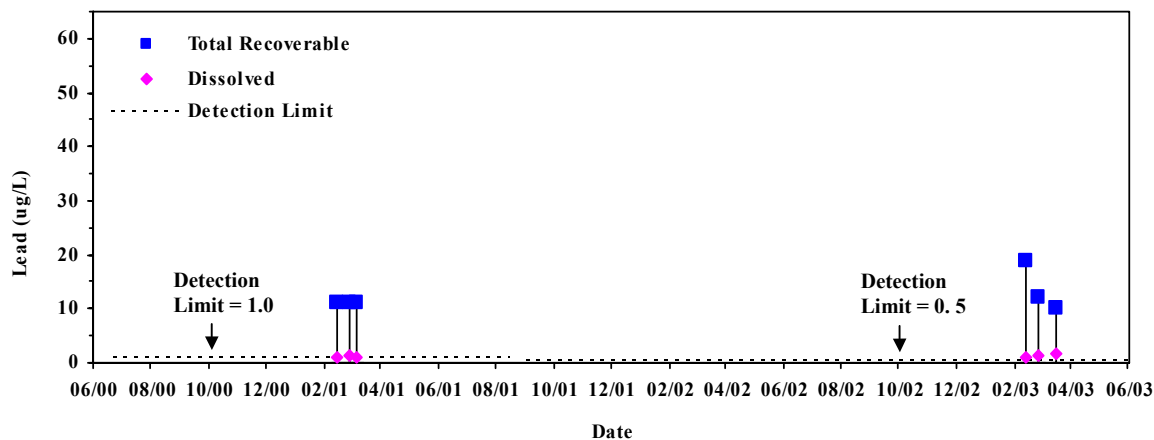


b)

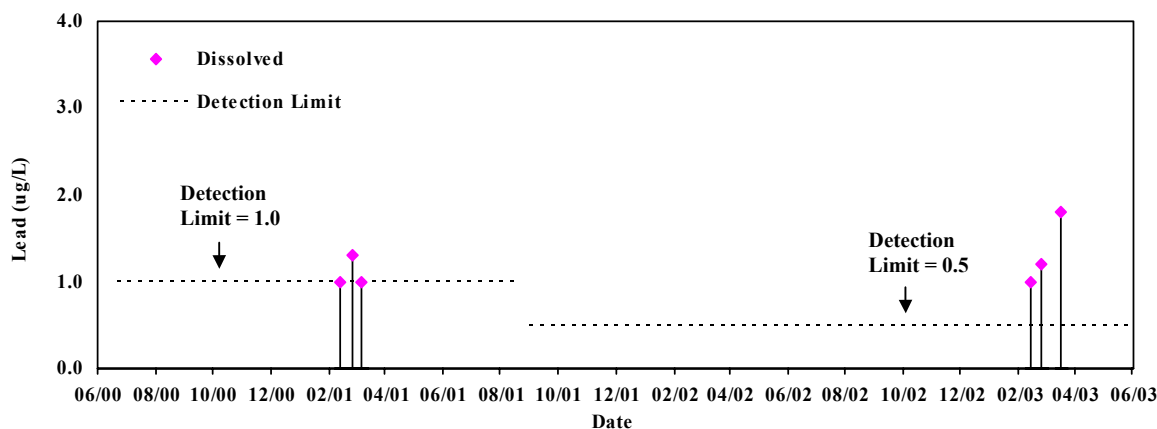


c)

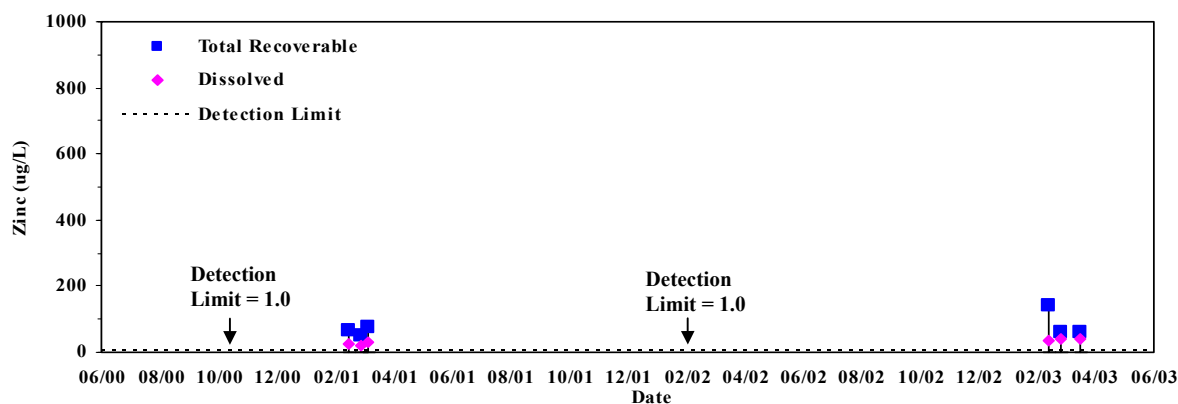
**Figure 9.10 Dominguez Gap Pump Station Chemistry Results: a) Cadmium; b) Copper; c) Nickel.**



a)

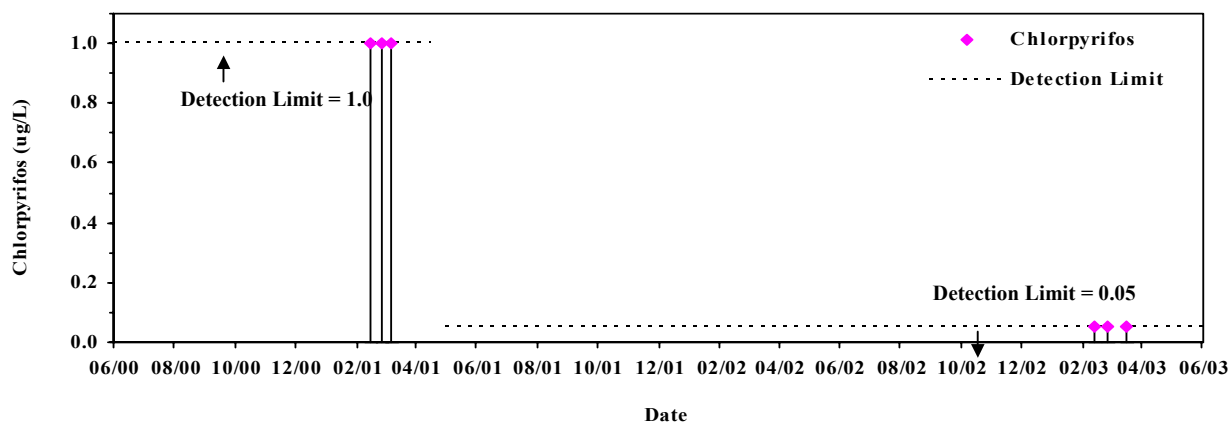


b)

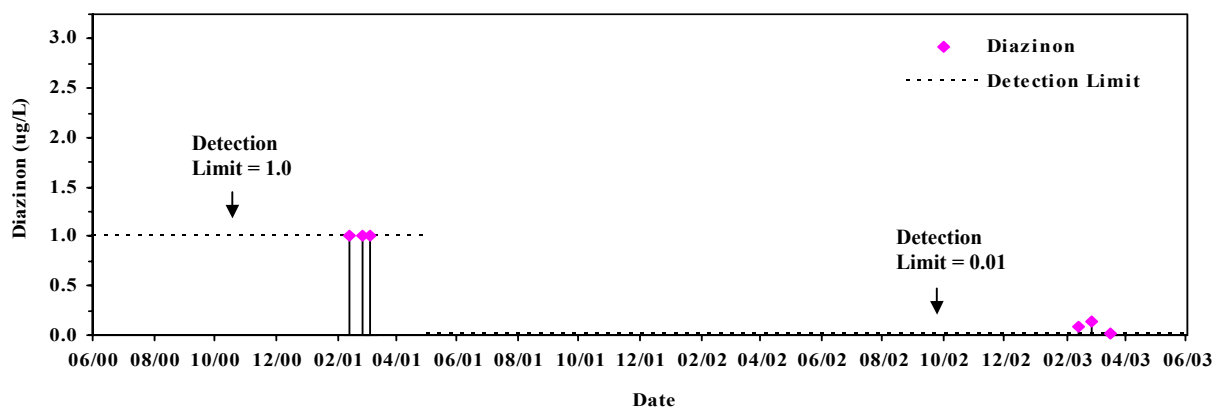


c)

**Figure 9.11 Dominguez Gap Pump Station Chemistry Results: a) Lead (total and dissolved); b) Lead (dissolved); c) Zinc.**

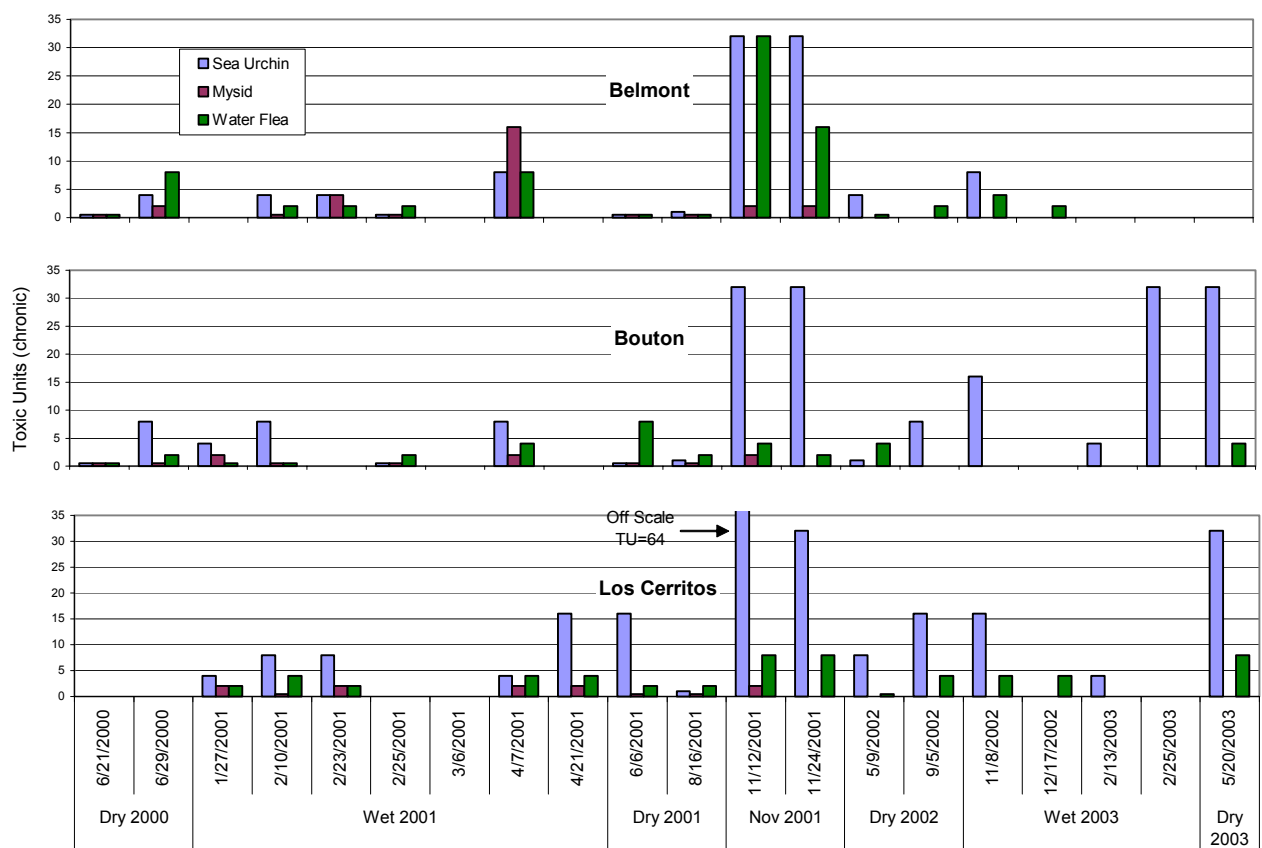


a)

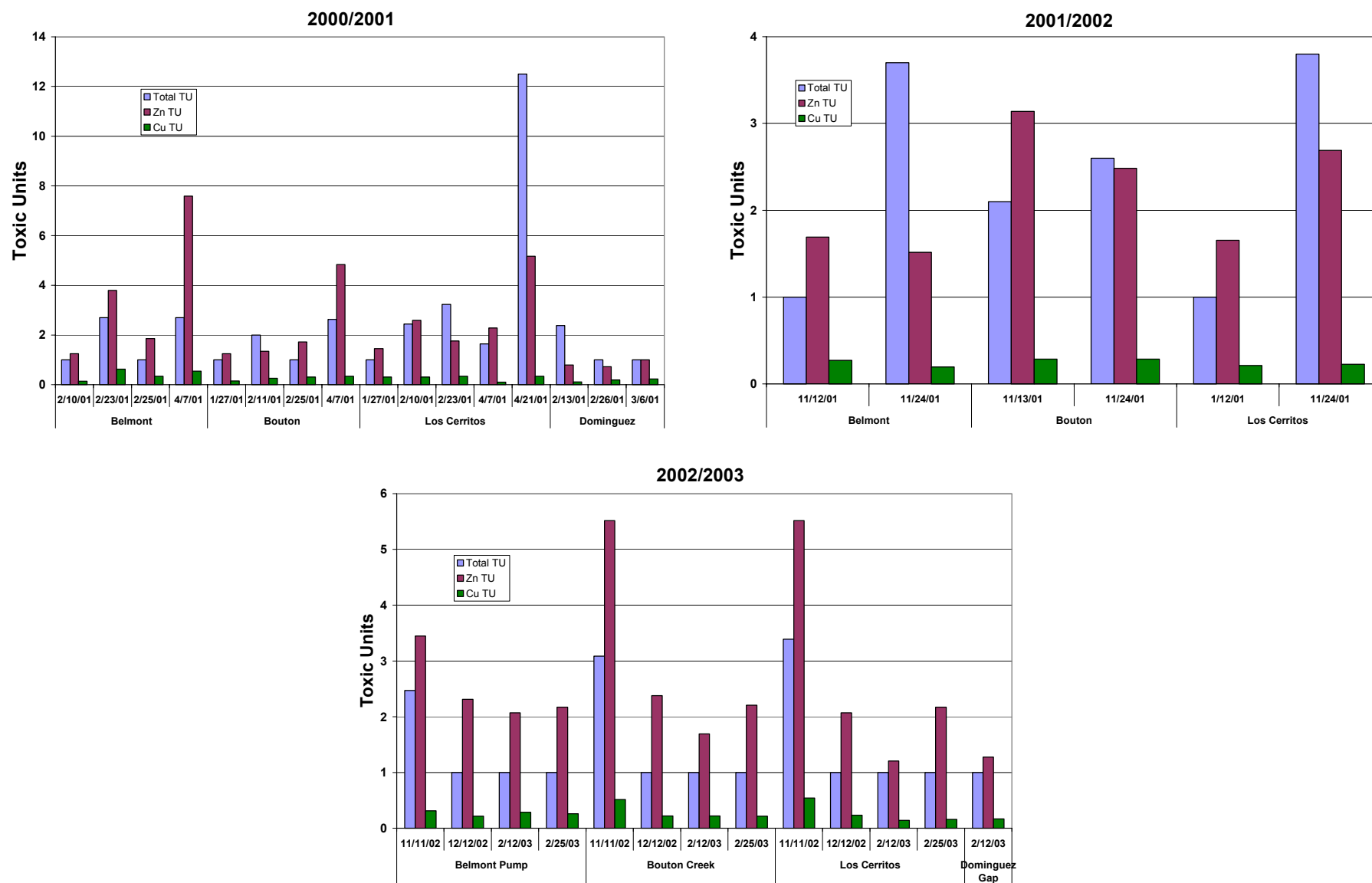


b)

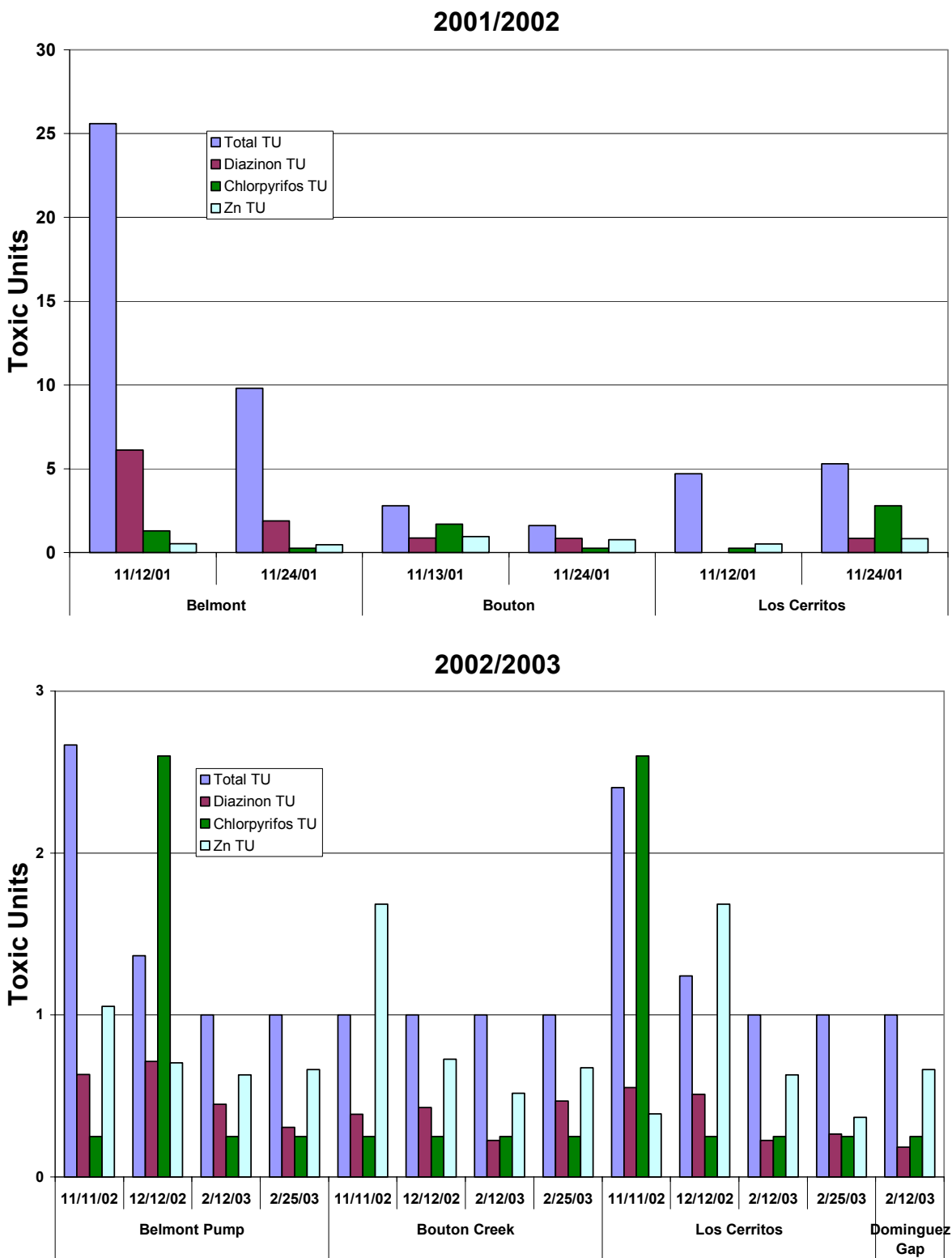
**Figure 9.12 Dominguez Gap Pump Station Chemistry Results: a) Chlorpyrifos; b) Diazinon.**



**Figure 9.13 Summary of Wet and Dry Weather Toxicity Results for all Long Beach Samples.**



**Figure 9.14 Comparison of Measured (Total) Toxic Units for the Sea Urchin Fertilization Test and Toxic Units Predicted from the Dissolved Concentrations of Copper and Zinc in the Test Samples.** Measured toxic units are based on the EC50 (100/EC50). A value of 1 toxic unit was assigned to low/nontoxic samples having an estimated EC50>100%.



**Figure 9.15 Comparison of Measured (Total) Toxic Units for the Water Flea Survival Test and Toxic Units Predicted from the Concentration of Chlorpyrifos, Diazinon and Dissolved Zinc in the Test Samples.** Measured toxic units are based on the EC50 (100/EC50). A value of 1 toxic unit was assigned to low/nontoxic samples having an estimated EC50 of >100.

**Table 9.1 Summary of Beneficial Uses for Receiving Water Bodies Associated with each Monitoring Location<sup>1</sup>**

DISCHARGE LOCATION	HYDRO. UNIT	COMM	EST	GWR	IND	MAR	MUN	NAV	RARE	REC1	REC2	SHELL	WARM	WET	WILD
Bouton Creek	405.15						P			P	I		I		E
Los Cerritos Channel	405.15						P			P	I		I		E
Dominguez Gap Pump Sta.	405.15			E	P		P			E	E		E		P
Belmont Pump Sta./Alamitos Bay	405.12	E	E		E	E		E	E	E	E	E		E	E

1. Source: California Regional Water Quality Control Board, Los Angeles Region. 1994. Water Quality Control Plan, Los Angeles Region, Basin Plan for the Coastal Watersheds of Los Angeles and Ventura Counties. P=Potential, E=Existing, and I=Intermittent

<b>Commercial and Sport Fishing (COMM):</b>	Uses of water for commercial or recreational collection of fish, shellfish, or other organisms including, but not limited to, uses involving organisms intended for human consumption or bait purposes.
<b>Estuarine Habitat (EST):</b>	Uses of water that support estuarine ecosystems including, but not limited to, preservation or enhancement of estuarine habitats, vegetation, fish, shellfish, or wildlife (e.g., estuarine mammals, waterfowl, shorebirds).
<b>Ground Water Recharge (GWR):</b>	Uses of water for natural or artificial recharge of ground water for purposes of future extraction, maintenance of water quality, or halting of saltwater intrusion into freshwater aquifers.
<b>Industrial Service Supply (IND):</b>	Uses of water for industrial activities that do not depend primarily on water quality including, but not limited to, mining, cooling water supply, hydraulic conveyance, gravel washing, fire protection, or oil well re-pressurization.
<b>Marine Habitat (MAR):</b>	Uses of water that support marine ecosystems including, but not limited to, preservation or enhancement of marine habitats, vegetation, such as kelp, fish, shellfish, or wildlife (e.g., marine mammals, shorebirds).
<b>Municipal and Domestic Supply (MUN):</b>	Uses of water for community, military, or individual water supply systems including, but not limited to, drinking water.
<b>Navigation (NAV):</b>	Uses of water for shipping, travel, or other transportation by private, military, or commercial vessels.
<b>Rare, Threatened, or Endangered Species (RARE):</b>	Uses of water that support habitats necessary, at least in part, for the survival and successful maintenance of plant or animal species established under state or federal law as rare, threatened, or endangered.
<b>Water Contact Recreation (REC-1):</b>	Uses of water for recreational activities involving body contact with water, where ingestion of water is reasonably possible. These uses include, but are not limited to, swimming, wading, water-skiing, skin and scuba diving, surfing, white water activities, fishing, or use of natural hot springs.
<b>Non-contact Water Recreation (REC-2):</b>	Uses of water for recreational activities involving proximity to water, but not normally involving body contact with water, where ingestion of water is reasonably possible. These uses include, but are not limited to, picnicking, sun bathing, hiking, beachcombing, camping, boating, tide pool and marine life study, hunting, sightseeing, or aesthetic enjoyment in conjunction with the above activities.
<b>Shellfish Harvesting (SHELL):</b>	Uses of water that support habitats suitable for the collection of filter-feeding shellfish (e.g., clams, oysters, and mussels) for human consumption, commercial, or sports purposes.
<b>Warm Freshwater Habitat (WARM):</b>	Uses of water that support warm water ecosystems including, but not limited to, preservation or enhancement of aquatic habitats, vegetation, fish, or wildlife, including invertebrates.
<b>Wetland Habitat (WET):</b>	Uses of water that support wetland ecosystems including, but not limited to, preservation or enhancement of wetland habitats, vegetation, fish, shellfish, or wildlife, and other unique wetland functions which enhance water quality, such as providing flood and erosion control, stream bank stabilization, and filtration and purification of naturally occurring contaminants.
<b>Wildlife Habitat (WILD):</b>	Uses of water that support terrestrial ecosystems including, but not limited to, preservation and enhancement of terrestrial habitats, vegetation, wildlife (e.g., Mammals, birds, reptiles, amphibians, invertebrates), or wildlife water and food sources.

**Table 9.2 Comparison of Water Quality Measurements from Bouton Creek with Guidelines and Standards**

<i>Bouton Creek</i>			Guidelines and Standards					Mass Emission				
Class Constituent	ML	Units	Ocean Plan 2001 <sup>d</sup>	Basin Plan	AB411	CTR (saltwater) <sup>b</sup>	CTR (freshwater) <sup>a,b</sup>	No. of Samples	No. of Nondetects <sup>e</sup>	Percent Detects	No. of Exceed.	Percent Exceed.
<b>CONVENTIONALS</b>												
BOD	4	mg/l						4	1	75		
COD	4-900	mg/l						4	0	100		
EC								4	0	100		
TOC	1	mg/l						4	0	100		
Hardness	1	mg/l						4	0	100		
Alkalinity	5	mg/l						4	0	100		
pH	0-14			<6.5 & >8.5				4	0	100	2	50
Cyanide	0.005	mg/l	0.004	0.2			0.0052	4	4	0	0	0
Chloride	1	mg/l						4	0	100		
Fluoride	0.1	mg/l						4	0	100		
TKN	0.1	mg/l						4	0	100		
Ammonia as N	0.1	mg/l	2.4					4	0	100	0	0
Nitrite N	0.01	mg/l						4	4	0		
Nitrate N	0.01	mg/l						4	0	100		
Total P	0.05	mg/l						4	0	100		
Diss. P	0.01	mg/l						4	0	100		
MBAS	0.02	mg/l		0.5				4	0	100	0	0
MTBE	0.5	mg/l						4	4	0		
Total Phenols	0.1	mg/l						4	4	0		
Oil & Grease	5	mg/l	75					4	4	0	0	0
Turbidity	1	NTU	225					4	0	100	0	0
TRPH	5	mg/l						4	4	0		
TSS	1	mg/l	3					4	0	100	4	100
TDS	1	mg/l						4	0	100		
TVS	1	mg/l						4	1	75		

**Table 9.2 Comparison of Water Quality Measurements from Bouton Creek with Guidelines and Standards (continued)**

<i>Bouton Creek</i>			Guidelines and Standards					Mass Emission				
Class Constituent	ML	Units	Ocean Plan 2001 <sup>d</sup>	Basin Plan	AB411	CTR (saltwater) <sup>b</sup>	CTR (freshwater) <sup>a,b</sup>	No. of Samples	No. of Nondetects <sup>e</sup>	Percent Detects	No. of Exceed.	Percent Exceed.
<b><i>BACTERIA (mpn/100ml)</i></b>												
Enterococcus	<20	MPN/100m l			104 (instantaneous)			4	0	100	3	75
Fecal Coliform	<20	MPN/100m l	400 (instantaneous)	200	400 (instantaneous)			4	0	100	4	100
Total Coliform	<20	MPN/100m l	10,000 (instantaneous)		10,000 (instantaneous)			4	0	100	4	100
<b><i>TOTAL METALS</i></b>												
Aluminum	25	ug/L		1000				4	0	100	4	100
Antimony	0.5	ug/L	220 <sup>h</sup>	6				4	0	100	0	0
Arsenic	0.5	ug/L	32	50				4	0	100	0	0
Beryllium	0.5	ug/L	0.033 <sup>h</sup>	4				4	4	0	0	0
Cadmium	0.25	ug/L	4	5				4	0	100	0	0
Chromium	0.5	ug/L		50				4	0	100	0	0
Hex Chromium	20	ug/L	8				11	3	3	0	0	0
Copper	0.5	ug/L	12					4	0	100	4	100
Iron	25	ug/L						4	0	100		
Mercury	0.2	ug/L	0.16	2				4	4	0	0	0
Nickel	1	ug/L	20	100				4	0	100	0	0
Lead	0.5	ug/L	8					4	0	100	4	100
Selenium	1	ug/L	60	50				4	4	0	0	0
Silver	0.25	ug/L	2.8					4	2	50	0	0
Thallium	1	ug/L	2.0 <sup>h</sup>	2				4	4	0	0	0
Zinc	1	ug/L	80					4	0	100	4	100
<b><i>DISSOLVED METALS</i></b>												
Aluminum	25	ug/L						4	1	75		
Antimony	0.5	ug/L						4	0	100		
Arsenic	0.5	ug/L				36	150	4	0	100	0	0
Beryllium	0.5	ug/L						4	4	0		
Cadmium	0.25	ug/L				9.3	1.3	4	3	25	0	0
Chromium	0.5	ug/L					100	4	0	100	0	0
Copper	0.5	ug/L				3.1	5.0	4	0	100	4	100

**Table 9.2 Comparison of Water Quality Measurements from Bouton Creek with Guidelines and Standards (continued)**

<i>Bouton Creek</i>			Guidelines and Standards					Mass Emission				
Class Constituent	ML	Units	Ocean Plan 2001 <sup>d</sup>	Basin Plan	AB411	CTR (saltwater) <sup>b</sup>	CTR (freshwater) <sup>a,b</sup>	No. of Samples	No. of Nondetects <sup>e</sup>	Percent Detects	No. of Exceed.	Percent Exceed.
Iron	25	ug/L						4	0	100		
Mercury	0.2	ug/L						4	4	0		
Nickel	1	ug/L				8.2	29	4	0	100	0	0
Lead	0.5	ug/L				8.1	1.2	4	0	100	4	100
Selenium	1	ug/L				71	5.0 <sup>c</sup>	4	4	0	0	0
Silver	0.25	ug/L					1.1 <sup>c</sup>	4	4	0	0	0
Thallium	1	ug/L					1.2 <sup>c</sup>	4	4	0	0	0
Zinc	1	ug/L				81	66	4	0	100	4	100
<b>CHLORINATED PESTICIDES</b>												
4,4'-DDD	0.05	ug/L						4	4	0		
4,4'-DDE	0.05	ug/L						4	4	0		
4,4'-DDT	0.01	ug/L				0.001	0.001	4	4	0	0	0
Aldrin	0.05	ug/L	0.000022 <sup>h</sup>			1.3 <sup>c</sup>	3 <sup>c</sup>	4	4	0	0	0
alpha-BHC	0.05	ug/L						4	4	0		
alpha-Chlordane	0.5	ug/L						4	4	0		
alpha-Endosulfan	0.05	ug/L				0.0087	0.056	4	4	0	0	0
beta-BHC	0.05	ug/L						4	4	0		
beta-Endosulfan	0.05	ug/L				0.0087	0.056	4	4	0	0	0
delta-BHC	0.05	ug/L						4	4	0		
Endosulfan Sulfate	0.05	ug/L	0.018					4	4	0	0	0
Endrin	0.01	ug/L	0.004	2		0.0023	0.036	4	4	0	0	0
Endrin Aldehyde	0.01	ug/L						4	4	0		
Dieldrin	0.01	ug/L	0.00004 <sup>h</sup>			0.0019	0.056	4	4	0	0	0
gamma-BHC	0.05	ug/L				0.95 <sup>c</sup>	0.16 <sup>c</sup>	4	4	0	0	0
gamma-Chlordane	0.5	ug/L						4	4	0		
Heptachlor	0.01	ug/L	0.00005 <sup>h</sup>	0.01		0.0036	0.0038	4	4	0	0	0
Heptachlor Epoxide	0.01	ug/L	0.00002 <sup>h</sup>	0.01		0.0036	0.0038	4	4	0	0	0
Toxaphene	0.5	ug/L	0.00021 <sup>h</sup>	3		0.0002	0.0002	4	4	0	0	0

**Table 9.2 Comparison of Water Quality Measurements from Bouton Creek with Guidelines and Standards (continued)**

<i>Bouton Creek</i>			Guidelines and Standards					Mass Emission				
Class Constituent	ML	Units	Ocean Plan 2001 <sup>d</sup>	Basin Plan	AB411	CTR (saltwater) <sup>b</sup>	CTR (freshwater) <sup>a,b</sup>	No. of Samples	No. of Nondetects <sup>e</sup>	Percent Detects	No. of Exceed.	Percent Exceed.
<i><b>AROCLORS</b></i>												
Aroclor 1016	0.5	ug/L						4	4	0		
Aroclor 1221	0.5	ug/L						4	4	0		
Aroclor 1232	0.5	ug/L						4	4	0		
Aroclor 1242	0.5	ug/L						4	4	0		
Aroclor 1248	0.5	ug/L						4	4	0		
Aroclor 1254	0.5	ug/L						4	4	0		
Aroclor 1260	0.5	ug/L						4	4	0		
Total PCBs	0.5	ug/L						4	4	0		
<i><b>ORGANOPHOSPHATE PESTICIDES</b></i>												
Atrazine	1	ug/L	3					4	4	0	0	0
Chlorpyrifos	0.05	ug/L						4	4	0		
Cyanazine	1	ug/L						4	4	0		
Diazinon	0.01	ug/L						4	0	100		
Malathion	1	ug/L						4	4	0		
Prometryn	1	ug/L						4	4	0		
Simazine	1	ug/L	4					4	2	50	1	25
<i><b>HERBICIDES</b></i>												
2,4,5-TP (Silvex)	0.5	ug/L	50					4	4	0	0	0
2,4-D	1	ug/L	70					4	4	0	0	0
Glyphosate	5	ug/L	700					4	4	0	0	0

<sup>a</sup> Based on a hardness of 50 mg/L

<sup>b</sup> Criteria continuous concentration which equals the highest concentration of pollutant to which aquatic life can be exposed for an extended period of time without deleterious effects.

<sup>c</sup> Criteria maximum concentration which equals the highest concentration of pollutant to which aquatic life can be exposed for a short period of time with deleterious effects

<sup>d</sup> Criteria based on daily maximum

<sup>e</sup> Expressed as total recoverable

<sup>f</sup> ML= Minimum Level

<sup>g</sup> Non-detect refers to a lab result value that is below them minimum level

<sup>h</sup> Criteria based on 30 day average

**Table 9.3 Comparison of Water Quality Measurements from Belmont Pump Station with Guidelines and Standards**

<i>Belmont Pump</i>			Guidelines and Standards					Mass Emission				
Class Constituent	ML	Units	Ocean Plan 2001 <sup>d</sup>	Basin Plan	AB411	CTR (saltwater) <sup>b</sup>	CTR (freshwater) <sup>a,b</sup>	No. of Samples	No. of Nondetects <sup>e</sup>	Percent Detects	No. of Exceed.	Percent Exceed.
<b>CONVENTIONALS</b>												
BOD	4	mg/l										
COD	4-900	mg/l										
EC												
TOC	1	mg/l						4	0	100		
Hardness	1	mg/l						4	0	100		
Alkalinity	5	mg/l						4	0	100		
pH	0-14			<6.5 & >8.5				4	0	100	1	25
Cyanide	0.005	mg/l	0.004	0.2			0.0052	4	4	0	0	0
Chloride	1	mg/l						4	4	100		
Fluoride	0.1	mg/l						4	1	75		
TKN	0.1	mg/l						4	0	100		
Ammonia as N	0.1	mg/l	2.4					4	0	100	0	0
Nitrite N	0.01	mg/l						4	4	0		
Nitrate N	0.01	mg/l						4	0	100		
Total P	0.05	mg/l						4	0	100		
Diss. P	0.01	mg/l						4	0	100		
MBAS	0.02	mg/l		0.5				4	0	100	0	0
MTBE	0.5	mg/l						4	4	0		
Total Phenols	0.1	mg/l						4	4	0		
Oil & Grease	5	mg/l	75					4	4	0	0	0
Turbidity	1	NTU	225					4	4	0	0	0
TRPH	5	mg/l						4	0	100		
TSS	1	mg/l	3					4	0	100	4	100
TDS	1	mg/l						4	0	100		
TVS	1	mg/l						4	1	75		

**Table 9.3 Comparison of Water Quality Measurements from Belmont Pump Station with Guidelines and Standards (continued)**

<i>Belmont Pump</i>			Guidelines and Standards					Mass Emission				
Class Constituent	ML	Units	Ocean Plan 2001 <sup>d</sup>	Basin Plan	AB411	CTR (saltwater) <sup>b</sup>	CTR (freshwater) <sup>a,b</sup>	No. of Samples	No. of Nondetects <sup>c</sup>	Percent Detects	No. of Exceed.	Percent Exceed.
<b><i>BACTERIA (mpn/100ml)</i></b>												
Enterococcus	<20	MPN/100m l			104 (instantaneous)			4	0	100	3	75
Fecal Coliform	<20	MPN/100m l	400 (instantaneous)		400 (instantaneous)			4	0	100	4	100
Total Coliform	<20	MPN/100m l	10,000 (instantaneous)		10,000 (instantaneous)			4	0	100	4	100
<b><i>TOTAL METALS</i></b>												
Aluminum	25	ug/L		1000				4	0	100	4	100
Antimony	0.5	ug/L	220 <sup>h</sup>	6				4	0	100	0	0
Arsenic	0.5	ug/L	32	50				4	0	100	0	0
Beryllium	0.5	ug/L	0.033 <sup>h</sup>	4				4	4	0	0	0
Cadmium	0.25	ug/L	4	5				4	1	75	0	0
Chromium	0.5	ug/L		50				4	0	100	0	0
Hex Chromium	20	ug/L	8					3	3	0	0	0
Copper	0.5	ug/L	12					4	0	100	4	100
Iron	25	ug/L						4	0	100		
Mercury	0.2	ug/L	0.16	2				4	4	0	4	100
Nickel	1	ug/L	20	100				4	0	100	0	0
Lead	0.5	ug/L	8					4	0	100	4	100
Selenium	1	ug/L	60	50				4	4	0	0	0
Silver	0.25	ug/L	2.8					4	3	25	0	0
Thallium	1	ug/L	2.0 <sup>h</sup>	2				4	4	0	0	0
Zinc	1	ug/L	80					4	0	100	4	100
<b><i>DISSOLVED METALS</i></b>												
Aluminum	25	ug/L						4	1	75		
Antimony	0.5	ug/L						4	0	100		
Arsenic	0.5	ug/L				36	150	4	0	100	0	0
Beryllium	0.5	ug/L						4	4	0		
Cadmium	0.25	ug/L				9.3	1.3	4	4	0	0	0
Chromium	0.5	ug/L					100	4	0	100	0	0
Copper	0.5	ug/L				3.1	5.0	4	0	100	4	100

**Table 9.3 Comparison of Water Quality Measurements from Belmont Pump Station with Guidelines and Standards (continued)**

<i>Belmont Pump</i>			Guidelines and Standards					Mass Emission				
Class Constituent	ML	Units	Ocean Plan 2001 <sup>d</sup>	Basin Plan	AB411	CTR (saltwater) <sup>b</sup>	CTR (freshwater) <sup>a,b</sup>	No. of Samples	No. of Nondetects <sup>a</sup>	Percent Detects	No. of Exceed.	Percent Exceed.
Iron	25	ug/L						4	0	100		
Mercury	0.2	ug/L						4	4	0		
Nickel	1	ug/L				8.2	29	4	0	100	0	0
Lead	0.5	ug/L				8.1	1.2	4	0	100	4	100
Selenium	1	ug/L				71	5.0 <sup>c</sup>	4	4	0	0	0
Silver	0.25	ug/L					1.1 <sup>c</sup>	4	4	0	0	0
Thallium	1	ug/L					1.2 <sup>c</sup>	4	4	0	0	0
Zinc	1	ug/L				81	66	4	0	100	4	100
<b>CHLORINATED PESTICIDES</b>												
4,4'-DDD	0.05	ug/L						4	4	0		
4,4'-DDE	0.05	ug/L						4	4	0		
4,4'-DDT	0.01	ug/L				0.001	0.001	4	4	0	0	0
Aldrin	0.05	ug/L	0.000022 <sup>h</sup>			1.3 <sup>c</sup>	3 <sup>c</sup>	4	4	0	0	0
alpha-BHC	0.05	ug/L						4	4	0		
alpha-Chlordane	0.5	ug/L						4	4	0		
alpha-Endosulfan	0.05	ug/L				0.0087	0.056	4	4	0	0	0
beta-BHC	0.05	ug/L						4	4	0		
beta-Endosulfan	0.05	ug/L				0.0087	0.056	4	4	0	0	0
delta-BHC	0.05	ug/L						4	4	0		
Endosulfan Sulfate	0.05	ug/L	0.018					4	4	0		
Endrin	0.01	ug/L	0.004	2		0.0023	0.036	4	4	0	0	0
Endrin Aldehyde	0.01	ug/L						4	4	0		
Dieldrin	0.01	ug/L	0.00004 <sup>h</sup>			0.0019	0.056	4	3	25	1	25
gamma-BHC	0.05	ug/L				0.95 <sup>c</sup>	0.16 <sup>c</sup>	4	4	0	0	0
gamma-Chlordane	0.5	ug/L						4	4	0		
Heptachlor	0.01	ug/L	0.00005 <sup>h</sup>	0.01		0.0036	0.0038	4	4	0	0	0
Heptachlor Epoxide	0.01	ug/L	0.00002 <sup>h</sup>	0.01		0.0036	0.0038	4	4	0	0	0
Toxaphene	0.5	ug/L	0.00021 <sup>h</sup>	3		0.0002	0.0002	4	4	0	0	0

**Table 9.3 Comparison of Water Quality Measurements from Belmont Pump Station with Guidelines and Standards (continued)**

<i>Belmont Pump</i>			Guidelines and Standards						Mass Emission				
Class Constituent	ML	Units	Ocean Plan 2001 <sup>d</sup>	Basin Plan	AB411	CTR (saltwater) <sup>b</sup>	CTR (freshwater) <sup>a,b</sup>	No. of Samples	No. of Nondetects <sup>e</sup>	Percent Detects	No. of Exceed.	Percent Exceed.	
<b><i>AROCLORS</i></b>									4	4	0		
Aroclor 1016	0.5	ug/L							4	4	0		
Aroclor 1221	0.5	ug/L							4	4	0		
Aroclor 1232	0.5	ug/L							4	4	0		
Aroclor 1242	0.5	ug/L							4	4	0		
Aroclor 1248	0.5	ug/L							4	4	0		
Aroclor 1254	0.5	ug/L							4	4	0		
Aroclor 1260	0.5	ug/L							4	4	0		
Total PCBs	0.5	ug/L							4	4	0		
<b><i>ORGANOPHOSPHATE PESTICIDES</i></b>									4	4	0	0	0
Atrazine	1	ug/L	3						4	4	0		
Chlorpyrifos	0.05	ug/L							4	3	25		
Cyanazine	1	ug/L							4	4	0		
Diazinon	0.01	ug/L							4	0	100		
Malathion	1	ug/L							4	3	25		
Prometryn	1	ug/L							4	4	0		
Simazine	1	ug/L	4						4	4	0	0	0
<b><i>HERBICIDES</i></b>									4	4	0		
2,4,5-TP (Silvex)	0.5	ug/L	50						4	4	0	0	0
2,4-D	1	ug/L	70						4	4	0	0	0
Glyphosate	5	ug/L	700						4	4	0	0	0

<sup>a</sup> Based on a hardness of 50 mg/L

<sup>b</sup> Criteria continuous concentration which equals the highest concentration of pollutant to which aquatic life can be exposed for an extended period of time without deleterious effects.

<sup>c</sup> Criteria maximum concentration which equals the highest concentration of pollutant to which aquatic life can be exposed for a short period of time with deleterious effects

<sup>d</sup> Criteria based on daily maximum

<sup>e</sup> Expressed as total recoverable

<sup>f</sup> ML= Minimum Level

<sup>g</sup> Non-detect refers to a lab result value that is below them minimum level

<sup>h</sup> Criteria based on 30 day average

**Table 9.4 Comparison of Water Quality Measurements from Los Cerritos Channel with Guidelines and Standards**

<i>Los Cerritos Channel</i>			Guidelines and Standards					Mass Emission				
Class Constituent	ML	Units	Ocean Plan 2001 <sup>d</sup>	Basin Plan	AB411	CTR (saltwater) <sup>b</sup>	CTR (freshwater) <sup>a,b</sup>	No. of Samples	No. of Nondetects <sup>c</sup>	Percent Detects	No. of Exceed.	Percent Exceed.
<b>CONVENTIONALS</b>												
BOD	4	mg/l						4	2	50		
COD	4-900	mg/l						4	0	100		
EC								4	0	100		
TOC	1	mg/l						4	0	100		
Hardness	1	mg/l						4	0	100		
Alkalinity	5	mg/l						4	0	100		
pH	0-14			<6.5 & >8.5				4	0	100	2	50
Cyanide	0.005	mg/l	0.004	0.2			0.0052	4	4	0	0	0
Chloride	1	mg/l						4	0	100		
Fluoride	0.1	mg/l						4	1	75		
TKN	0.1	mg/l						4	0	100		
Ammonia as N	0.1	mg/l	2.4					4	0	100	0	0
Nitrite N	0.01	mg/l						4	4	0		
Nitrate N	0.01	mg/l						4	0	100		
Total P	0.05	mg/l						4	0	100		
Diss. P	0.01	mg/l						4	0	100		
MBAS	0.02	mg/l		0.5				4	0	100	0	0
MTBE	0.5	mg/l						4	4	0		
Total Phenols	0.1	mg/l						4	4	0		
Oil & Grease	5	mg/l	75					4	4	0	0	0
Turbidity	1	NTU	225					4	0	100	0	0
TRPH	5	mg/l						4	0	100		
TSS	1	mg/l	3					4	0	100	4	100
TDS	1	mg/l						4	0	100		
TVS	1	mg/l						4	1	75		

**Table 9.4 Comparison of Water Quality Measurements from Los Cerritos Channel with Guidelines and Standards (continued)**

<i>Los Cerritos Channel</i>			Guidelines and Standards					Mass Emission				
Class Constituent	ML	Units	Ocean Plan 2001 <sup>d</sup>	Basin Plan	AB411	CTR (saltwater) <sup>b</sup>	CTR (freshwater) <sup>a,b</sup>	No. of Samples	No. of Nondetects <sup>e</sup>	Percent Detects	No. of Exceed.	Percent Exceed.
<b><i>BACTERIA (mpn/100ml)</i></b>												
Enterococcus	<20	MPN/100m l			104 (instantaneous)			4	0	100	4	100
Fecal Coliform	<20	MPN/100m l	400 (instantaneous)	200	400 (instantaneous)			4	0	100	4	100
Total Coliform	<20	MPN/100m l	10,000 (instantaneous)		10,000 (instantaneous)			4	0	100	4	100
<b><i>TOTAL METALS</i></b>												
Aluminum	25	ug/L		1000				4	0	100	4	100
Antimony	0.5	ug/L	220h	6				4	0	100	1	25
Arsenic	0.5	ug/L	32	50				4	0	100	0	0
Beryllium	0.5	ug/L	0.033h	4				4	4	0	0	0
Cadmium	0.25	ug/L	4	5				4	0	100	0	0
Chromium	0.5	ug/L		50				4	0	100	0	0
Hex Chromium	20	ug/L	8					3	3	100	0	0
Copper	0.5	ug/L	12					4	0	100	4	100
Iron	25	ug/L						4	0	100		
Mercury	0.2	ug/L	0.16	2				4	4	0	0	0
Nickel	1	ug/L	20	100				4	0	100	1	25
Lead	0.5	ug/L	8					4	0	100	4	100
Selenium	1	ug/L	60	50				4	4	0	0	0
Silver	0.25	ug/L	2.8					4	2	50	0	0
Thallium	1	ug/L	2.0h	2				4	4	0	0	0
Zinc	1	ug/L	80					4	0	100	4	100
<b><i>DISSOLVED METALS</i></b>												
Aluminum	25	ug/L						4	0	100		
Antimony	0.5	ug/L						4	0	100		
Arsenic	0.5	ug/L				36	150	4	0	100	0	0
Beryllium	0.5	ug/L						4	4	0		
Cadmium	0.25	ug/L				9.3	1.3	4	3	25	0	0
Chromium	0.5	ug/L					100	4	0	100	0	0
Copper	0.5	ug/L				3.1	5.0	4	0	100	4	100

**Table 9.4 Comparison of Water Quality Measurements from Los Cerritos Channel with Guidelines and Standards (continued)**

<i>Los Cerritos Channel</i>			Guidelines and Standards					Mass Emission				
Class Constituent	ML	Units	Ocean Plan 2001 <sup>d</sup>	Basin Plan	AB411	CTR (saltwater) <sup>b</sup>	CTR (freshwater) <sup>a,b</sup>	No. of Samples	No. of Nondetects <sup>e</sup>	Percent Detects	No. of Exceed.	Percent Exceed.
Iron	25	ug/L						4	0	100		
Mercury	0.2	ug/L						4	4	0		
Nickel	1	ug/L				8.2	29	4	0	100	0	0
Lead	0.5	ug/L				8.1	1.2	4	0	100	4	100
Selenium	1	ug/L				71	5.0e	4	4	0	0	0
Silver	0.25	ug/L					1.1c	4	4	0	0	0
Thallium	1	ug/L					1.2c	4	4	0	0	0
Zinc	1	ug/L				81	66	4	0	100	4	100
<b>CHLORINATED PESTICIDES</b>												
4,4'-DDD	0.05	ug/L						4	4	0		
4,4'-DDE	0.05	ug/L						4	4	0		
4,4'-DDT	0.01	ug/L				0.001	0.001	4	4	0	0	0
Aldrin	0.05	ug/L	0.000022h			1.3 c	3 c	4	4	0	0	0
alpha-BHC	0.05	ug/L						4	4	0		
alpha-Chlordane	0.5	ug/L						4	4	0		
alpha-Endosulfan	0.05	ug/L				0.0087	0.056	4	4	0	0	0
beta-BHC	0.05	ug/L						4	4	0		
beta-Endosulfan	0.05	ug/L				0.0087	0.056	4	4	0	0	0
delta-BHC	0.05	ug/L						4	4	0		
Endosulfan Sulfate	0.05	ug/L	0.018					4	4	0	0	0
Endrin	0.01	ug/L	0.004	2		0.0023	0.036	4	4	0	0	0
Endrin Aldehyde	0.01	ug/L						4	4	0		
Dieldrin	0.01	ug/L	0.00004h			0.0019	0.056	4	3	25	1	25
gamma-BHC	0.05	ug/L				0.95 c	0.16c	4	3	25	0	0
gamma-Chlordane	0.5	ug/L						4	4	0		
Heptachlor	0.01	ug/L	0.00005h	0.01		0.0036	0.0038	4	4	0	0	0
Heptachlor Epoxide	0.01	ug/L	0.00002h	0.01		0.0036	0.0038	4	4	0	0	0
Toxaphene	0.5	ug/L	0.00021h	3		0.0002	0.0002	4	4	0	0	0

**Table 9.4 Comparison of Water Quality Measurements from Los Cerritos Channel with Guidelines and Standards (continued)**

<i>Los Cerritos Channel</i>			Guidelines and Standards					Mass Emission						
Class Constituent	ML	Units	Ocean Plan 2001 <sup>d</sup>	Basin Plan	AB411	CTR (saltwater) <sup>b</sup>	CTR (freshwater) <sup>a,b</sup>	No. of Samples	No. of Nondetects <sup>g</sup>	Percent Detects	No. of Exceed.	Percent Exceed.		
<b><i>AROCLORS</i></b>								4	4	0				
Aroclor 1016	0.5	ug/L						4	4	0				
Aroclor 1221	0.5	ug/L						4	4	0				
Aroclor 1232	0.5	ug/L						4	4	0				
Aroclor 1242	0.5	ug/L						4	4	0				
Aroclor 1248	0.5	ug/L						4	4	0				
Aroclor 1254	0.5	ug/L						4	4	0				
Aroclor 1260	0.5	ug/L						4	4	0				
Total PCBs	0.5	ug/L						4	4	0				
<b><i>ORGANOPHOSPHATE PESTICIDES</i></b>														
Atrazine	1	ug/L						3		4	4	0	0	0
Chlorpyrifos	0.05	ug/L								4	3	25		
Cyanazine	1	ug/L								4	4	0		
Diazinon	0.01	ug/L								4	0	100		
Malathion	1	ug/L								4	4	0		
Prometryn	1	ug/L								4	4	0		
Simazine	1	ug/L						4		4	2	50	1	25
<b><i>HERBICIDES</i></b>														
2,4,5-TP (Silvex)	0.5	ug/L						50		4	4	0	0	0
2,4-D	1	ug/L						70		4	4	0	0	0
Glyphosate	5	ug/L						700		4	3	25	0	0

<sup>a</sup> Based on a hardness of 50 mg/L

<sup>b</sup> Criteria continuous concentration which equals the highest concentration of pollutant to which aquatic life can be exposed for an extended period of time without deleterious effects.

<sup>c</sup> Criteria maximum concentration which equals the highest concentration of pollutant to which aquatic life can be exposed for a short period of time with deleterious effects

<sup>d</sup> Criteria based on daily maximum

<sup>e</sup> Expressed as total recoverable

<sup>f</sup> ML= Minimum Level

<sup>g</sup> Non-detect refers to a lab result value that is below them minimum level

<sup>h</sup> Criteria based on 30 day average

**Table 9.5 Comparison of Water Quality Measurements from Dominguez Pump Station with Guidelines and Standards.**

<i>Dominguez Pump</i>			Guidelines and Standards					Mass Emission				
Class Constituent	ML	Units	Ocean Plan 2001 <sup>d</sup>	Basin Plan	AB411	CTR (saltwater) <sup>b</sup>	CTR (freshwater) <sup>a,b</sup>	No. of Samples	No. of Nondetects <sup>c</sup>	Percent Detects	No. of Exceed.	Percent Exceed.
<b>CONVENTIONALS</b>												
BOD	4	mg/l						3	2	33		
COD	4-900	mg/l						3	0	100		
EC								3	0	100		
TOC	1	mg/l						3	0	100		
Hardness	1	mg/l						3	0	100		
Alkalinity	5	mg/l						3	0	100		
pH	0-14			<6.5 & >8.5				3	0	100	2	67
Cyanide	0.005	mg/l	0.004	0.2			0.0052	3	3	0	0	0
Chloride	1	mg/l						3	0	100		
Fluoride	0.1	mg/l						3	1	67		
TKN	0.1	mg/l						3	0	100		
Ammonia as N	0.1	mg/l	2.4					3	0	100	0	0
Nitrite N	0.01	mg/l						3	2	33		
Nitrate N	0.01	mg/l						3	0	100		
Total P	0.05	mg/l						3	0	100		
Diss. P	0.01	mg/l						3	0	100		
MBAS	0.02	mg/l		0.5				3	0	100	0	0
MTBE	0.5	mg/l						3	3	0		
Total Phenols	0.1	mg/l						3	3	0		
Oil & Grease	5	mg/l	75					3	3	0	0	0
Turbidity	1	NTU	225					3	0	100	0	0
TRPH	5	mg/l						2	2	0		
TSS	1	mg/l	3					3	0	100	3	100
TDS	1	mg/l						3	0	100		
TVS	1	mg/l						3	0	100		

**Table 9.5 Comparison of Water Quality Measurements from Dominguez Pump Station with Guidelines and Standards. (continued)**

<i>Dominguez Pump</i>			Guidelines and Standards					Mass Emission				
Class Constituent	ML	Units	Ocean Plan 2001 <sup>d</sup>	Basin Plan	AB411	CTR (saltwater) <sup>b</sup>	CTR (freshwater) <sup>a,b</sup>	No. of Samples	No. of Nondetects <sup>c</sup>	Percent Detects	No. of Exceed.	Percent Exceed.
<b><i>BACTERIA (mpn/100ml)</i></b>												
Enterococcus	<20	MPN/100m l			104 (instantaneous)			3	0	100	2	66
Fecal Coliform	<20	MPN/100m l	400 (instantaneous)	200	400 (instantaneous)			3	0	100	3	100
Total Coliform	<20	MPN/100m l	10,000 (instantaneous)		10,000 (instantaneous)			3	0	100	3	100
<b><i>TOTAL METALS</i></b>												
Aluminum	25	ug/L		1000				3	0	100	3	100
Antimony	0.5	ug/L	220 <sup>h</sup>	6				3	0	100	0	0
Arsenic	0.5	ug/L	32	50				3	0	100	0	0
Beryllium	0.5	ug/L	0.033 <sup>h</sup>	4				3	3	0	0	0
Cadmium	0.25	ug/L	4	5				3	2	33	0	0
Chromium	0.5	ug/L		50				3	0	100	0	0
Hex Chromium	20	ug/L	8					3	3	0	0	0
Copper	0.5	ug/L	12					3	0	100	1	33
Iron	25	ug/L						3	0	100		
Mercury	0.2	ug/L	0.16	2				3	3	0	0	0
Nickel	1	ug/L	20	100				3	0	100	0	0
Lead	0.5	ug/L	8					3	0	100	3	100
Selenium	1	ug/L	60	50				3	3	0	0	0
Silver	0.25	ug/L	2.8					3	3	0	0	0
Thallium	1	ug/L	2.0 <sup>h</sup>	2				3	3	0	0	0
Zinc	1	ug/L	80					3	0	100	1	33
<b><i>DISSOLVED METALS</i></b>												
Aluminum	25	ug/L						3	0	100		
Antimony	0.5	ug/L						3	1	67		
Arsenic	0.5	ug/L				36	150	3	0	100		
Beryllium	0.5	ug/L						3	3	0		
Cadmium	0.25	ug/L				9.3	1.3	3	3	0	0	0
Chromium	0.5	ug/L					100	3	0	100	0	0
Copper	0.5	ug/L				3.1	5.0	3	0	100	3	100

**Table 9.5 Comparison of Water Quality Measurements from Dominguez Pump Station with Guidelines and Standards. (continued)**

<i>Dominguez Pump</i>			Guidelines and Standards					Mass Emission				
Class Constituent	ML	Units	Ocean Plan 2001 <sup>d</sup>	Basin Plan	AB411	CTR (saltwater) <sup>b</sup>	CTR (freshwater) <sup>a,b</sup>	No. of Samples	No. of Nondetects <sup>e</sup>	Percent Detects	No. of Exceed.	Percent Exceed.
Iron	25	ug/L						3	0	100		
Mercury	0.2	ug/L						3	3	0		
Nickel	1	ug/L				8.2	29	3	0	100	0	0
Lead	0.5	ug/L				8.1	1.2	3	0	100	2	67
Selenium	1	ug/L				71	5.0 <sup>e</sup>	3	3	0	0	0
Silver	0.25	ug/L					1.1 <sup>c</sup>	3	3	0	0	0
Thallium	1	ug/L					1.2 <sup>c</sup>	3	3	0	0	0
Zinc	1	ug/L				81	66	3	0	100	2	67
<b>CHLORINATED PESTICIDES</b>												
4,4'-DDD	0.05	ug/L						3	3	0		
4,4'-DDE	0.05	ug/L						3	3	0		
4,4'-DDT	0.01	ug/L				0.001	0.001	3	3	0	0	0
Aldrin	0.05	ug/L	0.000022 <sup>h</sup>			1.3 <sup>c</sup>	3 <sup>c</sup>	3	3	0	0	0
alpha-BHC	0.05	ug/L						3	3	0		
alpha-Chlordane	0.5	ug/L						3	3	0		
alpha-Endosulfan	0.05	ug/L				0.0087	0.056	3	3	0	0	0
beta-BHC	0.05	ug/L						3	3	0		
beta-Endosulfan	0.05	ug/L				0.0087	0.056	3	3	0	0	0
delta-BHC	0.05	ug/L						3	3	0		
Endosulfan Sulfate	0.05	ug/L	0.018					3	3	0		
Endrin	0.01	ug/L	0.004			0.0023	0.036	3	3	0	0	0
Endrin Aldehyde	0.01	ug/L						3	3	0		
Dieldrin	0.01	ug/L	0.00004 <sup>h</sup>			0.0019	0.056	3	3	0	0	0
gamma-BHC	0.05	ug/L				0.95 <sup>c</sup>	0.16 <sup>c</sup>	3	3	0	0	0
gamma-Chlordane	0.5	ug/L						3	3	0		
Heptachlor	0.01	ug/L	0.00005 <sup>h</sup>			0.0036	0.0038	3	3	0	0	0
Heptachlor Epoxide	0.01	ug/L	0.00002 <sup>h</sup>			0.0036	0.0038	3	3	0	0	0
Toxaphene	0.5	ug/L	0.00021 <sup>h</sup>			0.0002	0.0002	3	3	0	0	0

**Table 9.5 Comparison of Water Quality Measurements from Dominguez Pump Station with Guidelines and Standards. (continued)**

<i>Dominguez Pump</i>			Guidelines and Standards					Mass Emission					
Class Constituent	ML	Units	Ocean Plan 2001 <sup>d</sup>	Basin Plan	AB411	CTR (saltwater) <sup>b</sup>	CTR (freshwater) <sup>a,b</sup>	No. of Samples	No. of Nondetects <sup>e</sup>	Percent Detects	No. of Exceed.	Percent Exceed.	
<i>AROCLORS</i>								3	3	0			
Aroclor 1016	0.5	ug/L						3	3	0			
Aroclor 1221	0.5	ug/L						3	3	0			
Aroclor 1232	0.5	ug/L						3	3	0			
Aroclor 1242	0.5	ug/L						3	3	0			
Aroclor 1248	0.5	ug/L						3	3	0			
Aroclor 1254	0.5	ug/L						3	3	0			
Aroclor 1260	0.5	ug/L						3	3	0			
Total PCB's	0.5	ug/L						3	3	0			
<i>ORGANOPHOSPHATE PESTICIDES</i>													
Atrazine	1	ug/L	3	3	0	0	0						
Chlorpyrifos	0.05	ug/L	3	3	0								
Cyanazine	1	ug/L	3	3	0								
Diazinon	0.01	ug/L	3	0	100								
Malathion	1	ug/L	3	3	0								
Prometryn	1	ug/L	3	3	0								
Simazine	1	ug/L	4	3	1	67	0						0
<i>HERBICIDES</i>													
2,4,5-TP (Silvex)	0.5	ug/L						50	3	3	0	0	0
2,4-D	1	ug/L						70	3	3	0	0	0
Glyphosate	5	ug/L						700	3	3	0	0	0

<sup>a</sup> Based on a hardness of 50

<sup>b</sup> Criteria continuous concentration which equals the highest concentration of pollutant to which aquatic life can be exposed for an extended period of time without deleterious effects.

<sup>c</sup> Criteria maximum concentration which equals the highest concentration of pollutant to which aquatic life can be exposed for a short period of time with deleterious effects

<sup>d</sup> Criteria based on daily maximum

<sup>e</sup> Expressed as total recoverable

<sup>f</sup> ML= Minimum Level

<sup>g</sup> Non-detect refers to a lab result value that is below them minimum level

<sup>h</sup> Criteria based on 30 day average

**Table 9.6**      **Summary of Toxicity Characteristics of Stormwater from Various Southern California Watersheds.** Test Types: SF = sea urchin fertilization, MS = mysid survival/growth, DS = daphnid survival/reproduction.

<b>Location</b>	<b>Date</b>	<b>Test Type</b>	<b>Number of Samples</b>	<b>%Toxic</b>	<b>TUc</b>
<b>Long Beach</b>	2002-2003	SF	13	46	≤2-32
<b>Long Beach</b>	2002-2003	DS	13	31	1-4
<b>Long Beach</b>	2000-2002	SF	22	86	≤2-32
<b>Long Beach</b>	2000-2002	MS	20	55	1-16
<b>Long Beach</b>	2000-2002	DS	22	77	1->16
<b>Los Angeles River</b>	1997-1999	SF	4	100	4-8
<b>San Gabriel River</b>	1997-1999	SF	4	50	≤2-4
<b>Ballona Creek</b>	1996-1997	SF	13	85	≤4-32
<b>Chollas Creek</b>	1999-2000	SF	5	100	8-32
<b>Chollas Creek</b>	1999	MS	3	0	1
<b>Chollas Creek</b>	1999	DS	3	67	1-2

**Table 9.7 Summary of TIE Results for Each Sample.** The primary toxicant category indicates the chemical class most strongly indicated by the results. The secondary category indicates the chemical class indicated from partially effective TIE treatments.

Date	Station	Water Flea		Mysid		Sea Urchin	
		Primary Category <sup>a</sup>	Secondary Category <sup>a</sup>	Primary Category	Secondary Category	Primary Category	Secondary Category
Wet Weather Event:							
11/8/02	Belmont	OP	--	--	--	--	--
11/9/02	Bouton	--	--	--	--	Metal	--
11/9/02	Cerritos	--	--	--	--	Metal	NPO
Dry Weather Events:							
9/5/02	Cerritos	NPO	Metal (?)	--	--	--	--
5/20/03	Bouton	--	--	--	--	Metal	--
5/20/03	Cerritos	--	--	--	--	Metal	--

<sup>a</sup> OP = organophosphate pesticide, METAL = divalent trace metal, NPO = unspecified nonpolar organic, PARTICLE = toxicity associated with particulate fraction of sample.

**Table 9.8 Nonparametric Spearman Correlation Coefficients Showing the Relationship between Change in Chemical Concentration and Toxic Units for the Sea Urchin and Water Flea Toxicity Tests.** Toxic units are based on the EC50 (sea urchin fertilization, water flea reproduction) or LC50 (water flea survival). Values in bold are statistically significant at  $p \leq 0.05$  (\*) or  $p \leq 0.01$  (\*\*) or  $p \leq 0.001$  (\*\*\*). N=35 for all constituents except for diazinon, where n=19.

Constituent		Sea Urchin Fertilization TUa	Water Flea	
			Survival TUa	Reproduction TUa
TSS		0.02	<b>0.48**</b>	<b>0.51**</b>
TDS		0.13	<b>0.46**</b>	<b>0.43*</b>
TOC		<b>0.36*</b>	<b>0.72***</b>	<b>0.74***</b>
Cadmium	Dissolved	0.23	-0.04	-0.01
Chromium	Dissolved	0.09	-0.01	-0.01
Copper	Dissolved	<b>0.57***</b>	0.32	0.25
Lead	Dissolved	<b>0.43*</b>	<b>0.42*</b>	<b>0.40*</b>
Nickel	Dissolved	<b>0.50**</b>	<b>0.65***</b>	<b>0.64***</b>
Zinc	Dissolved	<b>0.57***</b>	<b>0.44*</b>	<b>0.42*</b>
Diazinon		0.04	0.26	0.22

## 10.0 CONCLUSIONS

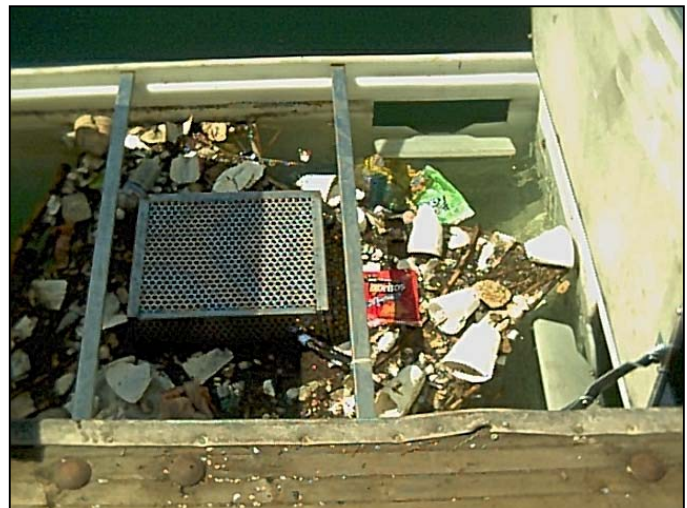
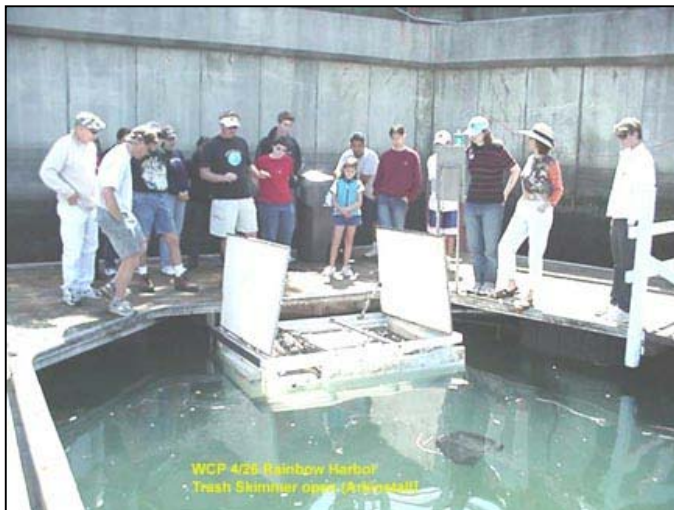
The City of Long Beach's water quality monitoring program for stormwater and dry weather discharges through the City's municipal separate storm sewer system (MS4) began in the 1999/2000 wet weather season under terms of Order No. 99-060 National Pollutant Discharge Elimination Systems Municipal Permit No. CAS004003 (CI 8052). Since that time about 37 wet weather monitoring events have been conducted at the four Long Beach mass emission stations, along with 32 dry weather inspections/monitoring events. Receiving water studies were also carried out in lower Alamitos Bay to document dry weather diversion effects on bacterial contamination and on toxicity associated with wet weather flow events. This last year, a pilot wet weather receiving water study was conducted throughout Alamitos Bay to document potential toxicity effects in the receiving waters in the Bay.

The Long Beach stormwater monitoring program has emphasized an approach of paired chemical analysis and toxicity testing of discharges of municipal stormwater. The purpose of this approach was to first identify the constituents in the City of Long Beaches stormwater discharges that exhibited potential water quality impacts. Also, since numerical stormwater quality standards do not exist, it was desired to measure the impacts of these discharges in the Long Beach receiving waters.

General conclusions that may be made from the data collected to this time are as follows:

- Exceedances of available benchmark values based upon receiving water, ocean water, drinking water or other available comparisons have been identified for some metals, primarily zinc and copper, and for diazinon and chlorpyrifos (organophosphate pesticides). Indicator bacterial counts also were high compared to standards for both wet weather and for dry weather discharges. Other factors such as dilution, duration, and transformation in the receiving waters must also be considered, along with California Toxics Rule (CTR) receiving water standards that apply to the Long Beach estuarine receiving waters or those applicable to the Los Angeles River.
- Several general temporal trends are emerging. Dissolved concentrations of cadmium, copper, nickel and lead appear to be comparable during both wet and dry weather periods. Unlike these four metals, dissolved zinc concentrations are consistently higher during storm events. Concentrations of total copper, lead and zinc are distinctly higher in association with storm flows. No distinct seasonal or year to year differences are evident in concentrations of total cadmium, total nickel, chlorpyrifos or diazinon. Characteristics of stormwater discharges from the Dominguez Gap Pump Station are consistent with earlier observations at this site. Discharges from this site tend have lower concentrations of total metals than the other mass emission sites. In addition, stormwater discharges are less frequent at Dominguez Gap because of the infiltration that occurs in the basin associated with this pump station.
- Stormwater discharges have consistently shown measured toxicity to freshwater and marine test species, but lesser or no toxicity after a series of storms or very large runoff events.
- Toxicity Identification Evaluations (TIEs) implicate organophosphate pesticides (diazinon and chlorpyrifos) in causing toxicity to the freshwater water flea (freshwater test). In addition, dissolved metals, primarily zinc and perhaps copper, are implicated in the toxicity to the purple sea urchin (marine test).
- The lower Alamitos Bay receiving water site monitored in previous years did not show measured toxicity to the marine test species (sea urchin fertilization test), consistent with the results of the laboratory toxicity tests, and with the measured dilutions in the receiving waters.

- This year's Pilot Receiving Water Program mapped the vertical and horizontal extent of a stormwater plume that developed in Alamos Bay in association with a brief, intense storm. The storm yielded 1.21 to 1.26 inches of rain in less than five hours. The plume extended from the surface down to depths of 3 to 6 feet throughout Alamos Bay, with salinities varying from 1 to 28 parts per thousand (ppt). Turbidity in the surface plume ranged from 45 to 80 Nephelometric Turbidity Units (NTU) in contrast to just 2 to 5 NTU in the underlying Alamos Bay water. The plume originated primarily from the Los Cerritos Channel. Total metals were highest at the lowest salinities, indicating stormwater as the source. Concentrations of total metals in the surface plume increased by about a factor of two from the higher salinity water near the mouth of the Bay (24.7 ppt) to the lowest salinity tested (8.7 ppt). Strong spatial trends were not evident in the distribution of dissolved metals. Organophosphate pesticides (OP pesticides) were mostly not detected, with Simazine, an herbicide being the only OP pesticide detected. Receiving water CTR standards were not violated in any of the four plume monitoring sites.
- Water samples from the four plume sites were tested for toxicity using the sea urchin fertilization test and showed negligible toxicity. Toxicity testing of discharges from the mass emission sites demonstrated a similar lack of toxicity, consistent with the high dilutions due to the large rainfall and low toxicity in stormwater runoff samples from the mass emission sites.



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